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Correspondence.—Wishing to make this JOURNAL a gazette of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, correspondence is solicited for publication from all who make the study of those subjects a pleasure or a profession.

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The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

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[OFFICIAL NOTICE.]

Where to Find the Western Gas Association's Exhibit, and the Custodian Thereof, at the World's Fair.

To the Fraternity: The exhibit of the Western Gas Association, at the World's Fair, St. Louis, is located in Section 33A, Liberal Arts Building, where Mr. Fred. R. Persons, who is in charge of the same, will always be on hand to receive visitors and to explain anything that requires explaining.

[OFFICIAL NOTICE.]

Twenty-Seventh Annual Meeting, Western Gas Association.

OFFICE OF SECRETARY,
NEW ALBANY, IND., April 25th, 1904.

The Twenty-seventh Annual Meeting of the Western Gas Association, in connection with the Gas Congress of all American Gas Associations, will be held at the Gas Exhibit Department of the Louisiana Purchase Exposition, St. Louis, Mo., June 14 to 18, 1904.

The sessions of the Western Association will be held June 14th, and will be called to order by the President, Mr. F. H. Shelton, at 10 A.M.

The various passenger associations have refused to grant the usual rates on the certificate plan, for the reason that all railroads have agreed to furnish rates to persons attending the St. Louis Exposition at a less rate than obtainable heretofore by the certificate plan.

A consultation with the passenger agents in the various localities will secure rates to St. Louis, with the privilege and restrictions imposed by the different rates obtainable.

The Hotel Jefferson will be the Association's headquarters, and Mr. E. G. Cowdery, Chairman of the Committee on Arrangements, announces that "The Committee will be represented at all times, in this location, by efficient help to be of assistance to delegates in any way they can."

The Committee of Arrangements announce rates at the various Hotels as follows:

Hotel Jefferson: $7 to $12 per day for room; privilege given for two persons to occupy a room.

Planters' Hotel: $3 per day per person; European plan. The hotel will place four persons to a room.

St. Nicholas Hotel: $7 per day and upward per room; European plan. Two persons privileged to occupy a room.

St. James Hotel: $7 per day per room, with privilege of two to four persons to each room.

The "Inside Inn," located upon the Fair Grounds, offers the following rates:

European Plan Includes Lodging and Daily Admissions.	Number of Rooms.	American Plan Includes Lodging and Daily Admissions.
$1.50 a day.....	500	.....$3.00 a day.
2.00 "	500	..... 3.50 "
2.50 "	500	..... 4.00 "
3.50 to 5.50 a day....	500 with bath	....$5.00 to 7.00 "

Children under 10, half rate.

LIBRARY OF CONGRESS MAY 16 1904 SMITHSONIAN DEPOSIT.

Single meals: Breakfast, 50 cents; luncheon, 50 cents; evening dinner, 75 cents. A la carte service at moderate prices.

Persons desiring to join the Association will have application blanks mailed to them upon application to the Secretary.

JAMES W. DUNBAR, Sec'y.

[NOTICE.]

Congress of American Gas Associations.

SECRETARY'S OFFICE,
58 WILLIAM ST., N. Y. CITY,
May 4, 1904.

The following Associations have agreed to participate in the Congress of American Gas Associations, to be held in St. Louis, June 15th and 16th: American Gas Light Association, New England Association of Gas Engineers, Western Gas Association, Pacific Coast Gas Association, Ohio Gas Light Association, Southwestern Gas, Electric and Railway Association, Michigan Gas Association, Wisconsin Gas Association, Kansas Gas, Water and Electric Light Association, Society of Gas Lighting, Guild of Gas Managers. The concurrence of all these Associations insures a successful Congress.

The following papers have been definitely promised:

"The Labor Question," by F. H. Shelton, Philadelphia, Pa.
"Gas Association Work," by Henry L. Doherty, New York city.
"Station Meters," by Donald McDonald, Albany, N. Y.
"Gas Inspection," by Ira C. Copley, Aurora, Ills.

It is intended to secure also either a paper, or a series of short papers, on the subject of "Inclined Retorts versus Horizontal Retorts Operated by Machinery."

A. E. FORSTALL, Sec'y.

[OFFICIAL NOTICE.]

Wrinkle Department, Western Gas Association.

WESTERN GAS ASSOCIATION,
OFFICE OF EDITOR, WRINKLE DEPARTMENT,
CLEVELAND, O., April 5, 1904.

This department is now open and ready for contributions, which will be presented at the Twenty-seventh Annual Meeting, to be held next June in St. Louis, Mo.

The active co-operation of all members and friends is earnestly solicited. Please forward contributions to the Editor at once.

W. E. STEINWEDELL, Editor.

BRIEFLY TOLD.

NOTES.—

THE South Hadley (Mass.) Gas Company has been reorganized with a capital of $5,000, nominal. The officers of the concern are: President, A. L. Wright; Treasurer, C. A. Gridley; Directors, A. L. Wright, C. A. Gridley and W. A. Burnett.

THE Massachusetts Board of Gas and Electric Light Commissioners has sanctioned the application of the Marlboro-Hudson Gas Company to issue $25,000 of stock, the proceeds of the issue to be devoted to retiring at par an equal value of shares in the Hudson Gas Light Company. The properties are in control of like interests.

AT the annual meeting of the shareholders in the Chester (Pa.) Gas Company the following result was reached in respect of the election for officers: Directors, Samuel A. Crozer, J. Howard Roop, Clarence Deshong, B. T. Hall and E. B. Johnson; President and Treasurer, J. Howard Roop; Secretary, E. B. Johnson.

ARRANGEMENTS for the supply of gas to Ambler, Pa., from the plant of the North Penn Gas Company, at Fort Washington, Pa., have been completed.

PORT CLINTON, O., is in the market for an artificial gas plant. The authorities, however, seem to think that the one who gets the franchise therefor should obligate himself to pay the entire running expenses of the town.

AT the annual meeting of the shareholders in the Milton (Pa.) Gas Company the Directors elected were: S. P. Brown, E. H. Heaton, W. A. Heinen, S. Davis, Marshall Wilson, Walter Wilson and T. C. Heinen.

A CORRESPONDENT in Mendota, Ills., writing under date of the 7th inst., says: "Contracts were signed this week for the sale of the two gas plants in Mendota, to Mr. William D. West, of Detroit, Mich., who represents solvent capitalists of that State. Mr. West is to take charge. The understanding just now is that the plant of the old Mendota Gas Company will be shut down for the purpose of revamping it, and that meanwhile the output will come from the plant of the Mendota Light and Heat Company. When the revamping is finished the supply will be from the new-old plant. I do not think there will be much more completion of, from, through or by separate lighting companies of any sort in Mendota.—A. F."

MR. BARBER B. CONABLE, of Buffalo, N. Y., has been appointed to succeed Mr. Edward C. Atwater as Receiver of the properties of the Consolidated Gas and Electric Company, of Batavia, N. Y.

THE gas supply of Charlotte, Mich., is now under the control of the Harvey Construction Company, of Chicago.

GAS is being satisfactorily supplied from the new plant at Berlin, Wis., of the Berlin Gas Company.

THE planning for the betterments on the plant of the Grand Rapids (Mich.) Gas Light Company, which may be traced to the genius of General Manager Wm. M. Eaton, will involve an expenditure of over $150,000. When the round-up is completed Grand Rapids will have a modern gas plant in every detail.

ELSEWHERE we note that Mr. A. P. Lathrop has resigned from the St. Paul (Minn.) Gas Light Company, in order to assume the active management of the plant and business of the Detroit City (Mich.) Gas Company. To that mention we here note that on the 6th inst. his former aides in the St. Paul Company, as a token of their esteem and goodwill, presented their retiring manager with a handsome silver set, which will be very useful in his home when coffee is to be served. The presentation speech was made by Secretary Crowley, and Mr. Lathrop, in acknowledging the gift, seemed not to be in good voice. The fact of the matter is, he was a trifle "flustered."

MR. HENRY I. LEA, Assistant Engineer to the Western Gas Construction Company, of Fort Wayne, Ind., has tendered his resignation, to become effective the 1st prox. Mr. Lea has not yet decided as to his next step, but has under consideration matters involving his return to the fold of active gas managers.

Underwriters to Investigate Fire Causes.

The announcement is made that the National Board of Fire Underwriters—a body comprising about 120 of the most important fire insurance companies, doing business in the United States (which companies have paid out in losses in this country during the last 10 years over $750,000,000, not including the recent conflagrations in Baltimore, Rochester and Toronto)—being thoroughly aroused by the continued great and apparently unnecessary fire waste of this country and especially the frequency of sweeping conflagrations in recent years, has undertaken to carefully investigate conditions existing throughout the country, in order to determine if possible more accurately than heretofore, where conditions exist which are conducive to the origin or spread of fire and to co-operate with the government—Federal, State and Municipal—by suggestions for the elimination of such conditions in order to check the present destruction of property so impoverishing to the nation and its citizens.

To carry out this object, a committee has been appointed, known as the Committee of Twenty of the National Board of Fire Underwriters, with instructions to define the congested districts of cities and determine their conflagration hazard, and for that purpose this committee is now organizing a staff of fire protection engineers, who will, after careful inspection, make reports on the construction, fire protection, electric hazard and other local conditions of cities, so that recommendations may be made for the adoption of better building laws, the improvement of water supplies and fire departments and the general safeguarding of hazards including electricity, handling of explosives, etc., etc.

For this work the committee will employ a number of men having had a technical education or training in the different branches of engineering which may fit them for work in such a cause. It is believed that the importance of this work will rapidly increase and that this engineering bureau will be a permanent adjunct of the national board. Men of ability, graduates of technical schools, will, therefore, probably find in such work an agreeable field for their ambitions, especially as few men at the present time have entered the profession of fire protection engineering, in which there seems to be such a promising future. Application blanks for employment on this corps of engineers have been prepared by the committee and can be procured by addressing Mr. Herbert Wilmerding, Secretary of the Committee, 46 Cedar street, New York.

[REVISED BY THE SECRETARY.—Continued from page 731.]

TWENTIETH ANNUAL MEETING, OHIO GAS LIGHT ASSOCIATION.

HELD IN THE HOLLENDEN HOTEL, CLEVELAND, O., MARCH 16, 17 AND 18, 1904.

SECOND DAY—MARCH 17.—AFTERNOON SESSION.

Continuation of the Report of the Committee on Uniformity of Gas Meters.

A new system of rating should be flexible. That is, it must allow a means of indicating any change in capacity that may occur by changed conditions, such as an improvement in meters. For example, we will assume that the present 5-light meter should be called a number 10 meter, and that under standard conditions it will pass 100 cubic feet of gas per hour. Change in construction may at some future time cause this meter to pass 130 cubic feet under the same standard conditions. We will then have, relatively, a number 13 meter, dropping the extra cypher for brevity. Such a system of rating might be easily applied to old meters.

It may seem at first that this system is open to the objection that before long we will have meters of all numbers from 5 to 500. This objection might be overcome by selecting from our present meters the best sizes and using their average capacity as a standard for sizes. Even though it is not to be entirely overcome, it is much more desirable to have meters of a great many different capacities and to know their capacities, than to have a great many meters of a great many different capacities, with a nomenclature that is not only inconsistent, but also misleading. I would suggest, therefore, that meters be rated at their actual capacity, the plan for nomenclature being as follows:

Old No.	New No.	Loss.	Capacity.
3	4	3-10	43
5	7	3-10	77
10	9	3-10	90
20	15	3-10	155
30	19	3-10	191
45	27	3-10	276
60	31	3-10	314
80	38	3-10	379
100	46	3-10	462

This table is submitted only as an example, showing plan of nomenclature. The tests are not accurate, as they were obtained from old meters and not corrected for temperature and specific gravity.

SELECTED ANSWERS TO QUESTIONS SENT OUT BY THE COMMITTEE.

Question.—Do you think that "rated capacity," as now used, should be changed so as to indicate the "actual capacity" of meters at a given differential pressure?

Answers.—Meters should be rated on the "actual capacity." Gas meters measure volume of gas in cubic feet, and the capacity rating to be consistent should be volumetric, and necessarily to be uniform should be at standard differential pressure and standard temperature.

I have always been of the opinion that the rated capacity as now used to indicate the output of the meters was an absurdity, and not indicative of the actual value of the meter at the pressure usually employed, and, therefore, to this question answer, "Yes, without any question."

The relation of "rated" to "actual" capacity of gas meters is an insolvent problem, and the writer considering conditions, cannot see what advantage would be gained by substituting a new system.

Even if a basis were established to-day, it might not hold good a few years from now. Meters are being improved all the time, and the capacities increased to as full an extent as good usage would direct.

Meters should be designated by numbers which would indicate their capacity without taxing the gas man's memory.

The "rated capacity" should indicate the "actual capacity," otherwise it means nothing.

Yes; should be rated in cubic feet per hour at a given differential pressure.

I think the rated capacity of meters is wrong, and that a change should be made.

Yes; if present rated capacity of meters is not correct it should be changed.

If you change the word "should" to "could," I answer, yes.

Question.—Would you be willing to change the rating on meters already in use, considering the inconvenience of re-rating them, altering records, familiarizing yourself with the new nomenclature, etc.?

Answers.—A change will be made in the rating of meters by this company, and we will be willing to work in unison with the Ohio Gas Light Association.

I would be willing to change from the present method of rating meters, now obsolete by the changed conditions of the gas business.

It would not inconvenience us, nor do I think it would confuse us at all in making the change.

I think all progressive gas companies will welcome it and use it.

If the Ohio Gas Light Association can induce the manufacturers to co-operate, I am sure that the gas companies will fall in line in the course of time. It will undoubtedly be a slow process.

Gas companies should be induced to use a new rating, provided the new rating brought about improvements in the meter design. A mere change in name, bringing no substantial benefit, would be a burden that gas companies would be slow to accept.

The co-operation of all Gas Light Associations would be necessary.

NOTE.—The committee would remark in passing that 25 gas men representing companies with an aggregate of over half a million meters in use, reported being willing and desirous of making a change. Four gas men, representing 83,000 meters in use, do not wish to make a change. They did not report, however, that they would not re-rate their meters if a new rating should be adopted.

The change would of necessity be gradual, owing to the number of meters already in use. A gas company would hardly be justified in removing all its meters at once to re-rate them, the logical time for making the change being when meters are removed for test and repair. Meter records, however, might be changed at once.

Question.—What suggestion can you make for a new system of rating that will indicate the actual capacity of the meter?

Answers.—A new system of rating would naturally be a numerical system, having a definite relation between the numbers selected and the volumetric capacity. To illustrate:

New Designation.	Volumetric Capacity.
No. 1	100 cubic feet per hour.
No. 2	200 " "
No. 3	300 " "
No. 4	400 " "
No. 5	500 " "
No. 6	600 " "
No. 10	1,000 " "

A number designation should be used, which for every increase of 1 in number would indicate an increase of 50 or 100 feet in the meter. If meters from now on were to be rated by numbers, all a man would have to do would be to remember that he was to multiply by 50 or 100 to get the capacity of the meter.

Establish the maximum speed or travel for diaphragm for each size with a fixed differential and initial pressure, and rate the meter accordingly.

I would suggest that meters be stamped by their capacity per hour in feet, and sold on their ability to do it on test by buyer.

I would suggest that a meter that will pass 100 cubic feet per hour at a given differential, should be known as a 100-foot meter.

It seems to me that the only change that would be reasonable, would be to put the number of feet per hour on the badge where the number of lights is now put.

Adopt sizes the average of existing sizes, and rate by capacity in cubic feet.

The recognized system of 6 feet per hour for each light marked on the meter, which is now established, and by which the meter is tested for accuracy in cases of disputes as to the accuracy of registration.

Question.—What differential pressure should be adopted as a standard to be used in rating capacity? (Consider the tendency toward high pressure, leakage through valves and diaphragms, etc.).

Answers.—I do not think that the capacity of meters should be rated at more than 3-tenths differential pressure. The large use of gas appliances and burners requiring high pressure makes it important that we should deliver gas at the burner under as high pressure as possible. All losses of pressure between the works and the burner should be reduced as low as possible, and we should not allow a large loss in the meters.

With the speed of travel limited to good practice, together with differential pressure not to exceed 2-tenths, there would be little or no increased demands on valves and diaphragms. The increase in pressure would apply to the case alone.

A differential pressure of 5-tenths inches is suggested as a standard in rating volumetric capacity of the meter.

I cannot see why meters cannot be so built that they need not be operated at a differential pressure to exceed 2-tenths. The lower the differential pressure can be kept the better, and if meters are built with a minimum friction in the working parts and ample area in all gas

passages, the meter could be worked to the most economical point regarding speed without subjecting the diaphragms to any great difference in pressure.

This is a little hard to answer, as circumstances might make a very great change in what was best. I would say, however, not more than ½ inch, and would also say that the latter part of the question from the word "consider" has no relevancy to the question. Five-tenths.

We would suggest that a differential pressure of ½ inch be used in adopting a standard.

Should be determined by a series of careful experiments.

Question.—Do you believe, should this association adopt a standard rating, that meter manufacturers could be induced to use it?

Answers.—If a majority of the gas men of the country should request it, manufacturers could hardly refuse to adopt it.

Not unless the rest of the gas fraternity adopted it also.

I believe they could if we try hard enough.

I would say that the adoption of a proper standard of rating by the Ohio Gas Light Association would be accepted by meter manufacturers, as I have received a great many comments upon the data contained in last year's Question Box, and I think it is the purpose of gas men generally to give the subject more thought in the future than they have given it in the past; and I think they will see the wisdom of adopting some rational system of rating rather than the present system.

Yes; if rating is ratified by other Associations.

Yes; for public opinion could be used to press the gas companies to demand it.

The adoption of a standard rating by an association of gas men would not necessarily influence the acceptance of the same by the meter manufacturers. It would need concerted action by the companies purchasing meters. At the same time, the agitation of the subject by our Association would be useful in stimulating the activity of the manufacturers toward improvement in meter design.

Most assuredly.

No; but it would probably be done by united action of all companies.

I do not believe that the adoption by your Association of a standard rating would induce manufacturers to use it, or the adoption by any individual association or company, but I am certain if you took the initiative in the matter you could probably command the assistance of all other Gas Associations in the United States, and thus compel manufacturers to make the change.

Question.—Could gas companies be induced to use a new rating?

Answers.—I think all progressive gas companies will welcome it and use it.

Yes; most gas companies operate electric stations, and electric meters are rated in quantity of current passed, not in lights capacity.

Gas companies could be induced to use a new rating, provided the new rating brought about improvements in meter design. A mere change in name, bringing no substantial benefit, would be a burden gas companies would be slow to accept.

Most assuredly.

Do not see any reason why they should not, as they would be the gainers.

Assuming that gas companies are managed by intelligent people, I answer, yes.

A majority of gas companies would adopt no rating except that concurred in by manufacturers marking meters accordingly. Some would promise to do anything, and then do anything to the contrary, as evidenced in other matters of a technical nature.

Gradually.

If the Ohio Association can induce the manufacturers to co-operate, I am sure that the gas companies will fall in line in course of time. It will undoubtedly be a slow process.

Question.—Would much confusion be the result of a partial adoption only?

Answers.—I do not see that any confusion whatever would result from its partial adoption. The capacities of the present should be changed slightly, so that our present 5-light meter would have a capacity corresponding, we will say, to our No. 2 meter, and the 10-light meter would be given double the capacity of the 5-light meter and would correspond to our No. 4 meter.

Yes; adoption should be general by manufacturers and gas companies.

Not if proper systematic methods of recording are used.

A partial adoption of the change in system would necessarily bring out confusion to the destruction of present familiar ratings.

Certainly not. Its application would be limited to a very few people, instead of applied to the masses, as in case of "metric system."

Do not see where any confusion could arise. Should there be any, parties affected would soon conform to the new order of things "per force of circumstances."

Consusion would be the natural result of a partial adoption of any rating system of general interest to the industry.

Question.—Is it probable that at some future time the rating we might now adopt will also become obsolete or meaningless through change of condition—high pressure, for instance?

Answers.—No, if a proper one were adopted.

If made good now, would remain for a long time.

I would say that no standard should be adopted that is not based on positive quantity, as gas will probably always be sold by the cubic foot or decimal multiples thereof. I cannot conceive how a rating based on the volume capacity of the meter can become obsolete.

Not likely, as service pressure would not vary greatly.

So long as gas is sold by volumetric standard, would not become obsolete. If gas was sold by weight or by heat units, some other standard of value would be necessary.

Probably not, unless high pressure should be so greatly increased as to make a large difference in volume, under which conditions the base rate would have to be arranged to suit a given pressure. So far, however, regulators are placed on the inlet side of the meter.

I do not regard it as possible that the rating now adopted might become obsolete. If gas meters should be designed and built for high pressure, running, say, to 25 or 100 pounds, there would be a possibility; but I take it that, for almost all time to come, where high pressure is employed, district governors will regulate the pressure in districts or upon individual meters, as the case may be. The meter, as a fact, will operate always under low pressure.

Conditions naturally change, and a rating suitable for to-day might be lacking in some measure to-morrow.

If we fail to adopt standards because they will in time become obsolete all progress will cease.

We could not conceive of any change which would result in another change of basis of rating of meters. Our whole system of gas measurement is based on cubic feet per day or per hour. Our unit of measurement being cubic feet, and is becoming more so, since, as stated above, the adoption of the mantle light, wherein the consumption is cubic feet, and unless we would adopt some other measurement than cubic feet, we fail to see where any future change could be effected, unless as we above state, we go to the metric system; then as a natural consequence our change in rating would be a change following our change in measurement for selling purposes and would fall in very readily, and to our mind far more easily, than if we would continue at the present rating of meters.

Question.—Do you regard an ordinary "U"-gauge sufficiently delicate to measure the differential pressure in making these tests for capacity?

Answers.—A "U"-gauge with a diagonal leg would give extremely accurate readings for the purpose.

I would say that reading of the "U"-gauge is not particularly accurate on a very low pressure, but a gauge set on an angle with a very small bore will give considerable travel for a small difference in pressure. Such a gauge will be found illustrated in the 1901 Wrinkle Department of the Ohio Gas Light Association.

No; tubes should be of the same diameter and scale should be correct. A gauge that will slide on tubes, pointing across the scale, should be a part of instrument.

No; as genera lly tubes are too small and far apart to hold down the personal error in reading.

The ordinary "U"-gauge is not sufficiently accurate to measure the differential pressure. An arch gauge of the King type, reading the hundredths of an inch, should be employed.

Question.—Is it true that the more recently constructed meters have a slightly greater and more uniform capacity than the older ones?

Answers.—I would say that the tendency is toward an increase in capacity and greater uniformity. Just what the future plans of the meter manufacturers are, I do not know. I do not think they have had very definite plans or have been trying to work to any particular end.

It is true that the more recently constructed meters have a greater capacity than the older meters. For instance, the present 3-light meter has a greater capacity than an old 5-light meter.

In my experience it is true that the present 2-diaphragm meters have less capacity and less uniformity than the former 3-diaphragm rotary valve meters.

The established meter manufacturers are making better meters than were made years ago. Yet there has been nothing approaching revolution in the product.

My experience is that the later patterns of meters have a greater capacity than the old pa tterns.

Decidedly. We know this from a series of tests covering meters of all manufacturers and of many dates, going back as much as 15 years.

Question.—Are the capacities of different makes of new meters of same size nearly uniform?

Answers.—Not nearly so much variation as there was 15 years ago.

For the smaller meters, say, 3-light, 5-light and 10-light sizes, the capacities of the different makes are practically the same. For larger sizes the differences are quite marked.

My experience is that different makes of meters of the same size are uniform in every respect, there being only one exception, that of the recent meter with glass valves put upon the market, which, for its rated capacity, has a larger output than any other meter I have ever had experience with.

Question.—How much is the capacity of meters of the same size and make affected by such conditions as flexibility of diaphragm, valve friction, solder dropped in channels, stuffing boxes packed too tight, bent working parts, or other unnecessary friction not detected in assembling?

Answers.—I don't know. New meters are practically uniform.

Reduction of capacity can be any amount, according to the flexibility of diaphragm, valve friction, stoppages, etc.

The difficulties you mention should be determined by test and inspection of the manufacturer before sending the meters out.

The matters here referred to are liable to exist in all constructions, and are supposed to be discovered by inspection and test under fixed conditions.

The capacities of meters, due to the conditions you name, might vary from 20 to 75 per cent. No meter is allowed to leave our shop to be placed without being throughly examined and all the defects you mention corrected. In other words, we do not accept the correctness of any meter upon the "say so" of the manufacturer, but satisfy ourselves that it will do all that is claimed, by taking it apart and adjusting all troubles where upon test it shows it is defective in any respect.

Question.—What suggestions can you make toward the improvement of meters?

Answers.—Better tin in bottom.

Make them of stronger and heavier tin.

I think something better than a soldered joint should be made to the spindle driving the valve mechanism. I also think a rigid steel tie of some sort should be made between the outlet and the inlet of the meter, and a better soldered joint should be made to the tin tubes on the side of the meter. This could be done by extending the long-threaded connecting piece so it would be smooth and have a slight taper, extending say a distance of 2 inches down the tube, and the space between the tube and the tail of the connection filled with solder. I also believe there is a field for meters with iron cases, to be used in those places where the setting of the meter is apt to be permanent, and removal is only likely to take place for testing or repairs. A more durable case would lessen the cost of maintenance, and many meters would pass through the burning of a building without injury, as often they are subjected to only sufficient heat to melt the soldering joint and permit the heated gases to reach the internal portions of the meter.

Keep all channels and parts of casing away from leather of diaphragm; keep exposed seams away from hidden seams so that when one seam is being soldered up the other is not being melted; as to square meters, do away with valve box and separate the dial from gas chamber as in the round meter.

An inexpensive and reliable attachment to the meter for use in indicating and recording time and rate of consumption. Straight reading dials. Three-light and 5-light meters, with same sized nipples for connections, and connections preferably for 1 inch pipe; threaded swivels for iron pipe connections; stronger jointing of the meter connection to the tin pipes on inlet and outlet—with the use of iron pipe for connections to house piping, there is much twisting and breaking due to the strain of the connection; raise diaphragm to keep bottom free from rubbing and condensation on bottom plate of meter.

While the improvement of the gas meter will depend primarily upon the manufacturers, the practice of using large meters, if adopted by gas companies, will make necessity of immediate improvement less prominent. Several attempts to construct and market an uncomplicated, cheap and reliable meter have failed in recent years. After all has been said and done, it must be a very satisfactory article that will eventually be a substitute for the present gas meter as constructed.

We have only one suggestion for the time being; that is, a meter that does not require three-fourths of the time necessary to repair in getting at the parts to be repaired, as we think the present form of meter about as inconvenient from this point of view as could be made. Whether or not a radical change would be possible, we are not prepared to state at the present time.

The suggestions which we have been making to the makers for the last 2 years have been principally in the line of increased diameter of diaphragm casings, decreased travel, increased area of valve ports and channels and harder and stiffer flag arms, links, connections, etc. In this connection would call attention to the meter recently designed by Mr. Harrington, Superintendent of Meters of the Consolidated Gas Company, New York, doing away with the valve chamber and channels and using the proper portion of the meter for the inlet gas.

Protect your meters by placing a drip on distribution riser to catch condensation flowing back from house pipes. This drip should seal gas supply off before allowing condensation to flow into meter.

NOTE.—The committee asked a meter manufacturer for an opinion from his standpoint regarding some of the suggestions made above. These opinions are given below:

Straight reading indexes of various sorts have been tried and abandoned. It would seem as though a device that would recommend itself mechanically might be found, but up to this time no really satisfactory device has been brought to the attention of the meter manufacturers.

Iron Meter Cases.—Dry meters in cast iron cases have been on the market for years.

Abolish unnecessary sizes. This will, no doubt, come in time. As an instance, it might be mentioned that one large factory has of late discontinued the manufacture of 80-light meters.

Keep Channels and all Parts of Case Away from Diaphragm.—This is a mooted question among meter manufacturers, and has been under discussion for years, some well-known makers claiming that a diaphragm that touches the case of the meter is best. Careful experiments are being made with a diaphragm that does not touch, a considerable number of meters with such diaphragms having been made and sent out, and careful record is being kept of them.

Abolish Valve Box and Separate the Dial from the Gas Chamber same as in Round Meters.—This practice obtained in meters for years and was abandoned years ago. Its re-adoption would not be an improvement, but a retrogression.

Same Sized Nipples for Connecting 3 and 5-Light Meters.—There is possibly some demand for this, but it would be a radical step, and a better solution may be found in the gradual abandonment of the 3-light meter and an increasing use of the 5-light. The demand for such a connection is by no means general; and in line with this, attention is called to the very great effort that has been made for years to have the standard meter union adopted, in spite of which nearly one-fifth of the meters made in this country to-day have connections not standard at the desire of the purchasers, showing how difficult it is to have undoubted improvement adopted generally.

Threaded Swivels for Iron Pipe.—Standard swivels with regulation pipe thread can be obtained of any meter manufacturer.

Question.—Would quick operating valves be practicable?

Answers.—It is essential that valves should be clean, and they should be self-cleaning as much as possible. Rotary valves and poppet valves have been tried, but the slide valve has proven the most generally satisfactory.

Never saw such application. Anything which would tend to complicate would be very objectionable.

No; there are too many risks attendant upon the operation of quick opening valves in meter construction, and an element of danger and uncertainty, which I do not believe we can afford to take risks on.

We hardly think quick opening valves would be a possible feature, as it would be almost impossible to construct a quick opening valve that the seat will not be exposed very largely to the different deposits from gas, and the shearing effect to a certain extent would be entirely done away with. We, therefore, think a self-opening valve would put us up against considerable trouble. However, eliminating the above features, we think the quick opening valve the ideal one, but whether practical or not we rather think not.

Question.—Would it be practicable in meter shop practice to adopt a certain standard drop in pressure by which meters should be tested for capacity before leaving shop; assuming, of course, that should the meter not reach this standard the fault would lie in assembling its parts?

Answers.—I see no reason why meter shops could not work to a standard drop in pressure in building and testing meters. A 2 per cent. variation either way would, no doubt, be allowable in capacity test; that is, a meter rated at 100 cubic feet per hour capacity would be

acceptable to the gas company if the capacity tests showed from 98 cubic feet to 102 cubic feet per hour.

It is entirely practicable, I should say. All motors are tested under fixed conditions; why not a meter?

I consider it eminently proper that the meters should be brought up to the capacity before being sent out of the shop.

From the meter makers' standpoint there is no necessity for such a question.

I think it would be entirely proper to submit the meters to a fixed flow of gas and reject them if the drop in pressure through the meter is excessive at this predetermined flow, and if drop in pressure is more than is known that meter can be constructed to give.

We practically do this now in our current practice. We believe that the more progressive meter manufacturers see the trouble ahead, and are not only willing but anxious to make such improvements as they can. One of the largest manufacturers expressed this to me a few days since his appreciation of Mr. Harrington's work, and said he was very anxious indeed to see any improved construction of this sort adopted.

Would say in meter shop practice is where the standard of drop pressure covering the capacity of meters should be adopted, and reference to it in the gas works should only be to confirm or assure yourselves that you are getting meters to the standard required.

It is not the part of the purchaser to make the meter to the standard, but the builder, and also a part of his responsibility to determine where the fault was if they do not come up to the adopted standard. The standard cited, that of capacity based on 5 inches, we think a very safe one for gas companies, and also a very reasonable one for the manufacturer. It may possibly reduce the rating of the present meter very materially; but even so, you would know what you were getting and feel assured that your meter was capable of doing the work for which you installed it.

So far as the size required, it would be entirely within the judgment of the gas engineer as to what size meter under the new standard he could use for certain work, but at the same time he would know when he selected a meter exactly what work it would do, and would not have to cut and try, or, in other words, substitute meters for ones placed on a supposed basis of capacity, such as we have now.

Question.—Can you make any other suggestions bearing on the subject?

Answers.—The only further suggestion that I can make is that after experimenting on the meters, the results of the experiments be canvassed with the Committee of Meter Manufacturers, which committee will undoubtedly do everything that is possible to standardize and improve the meters.

I think a saving could be made by the use of a very inexpensive volumetric governor on the outlet of the meter to prevent the safe working capacity of the meter from being exceeded. We are undoubtedly subjected to meter depreciation owing to the excessive demands, but whether we could save enough on lost gas or meter repairs to pay for the use of this volumetric regulator, I do not know. We could, however, to advantage make the point of greatest congestion of the meter at the outlet of the meter, and accomplish almost the same purpose of the volumetric governor. The congestion at this point would greatly lessen the differential pressure to which the meter might be subjected.

I have long been in favor of a direct-reading meter dial.

Should like to see all meters fitted with straight reading meter dials, so that errors in taking statements could not possibly occur, although they might be taken by inexperienced help.

I have always felt that the use of direct reading meter dials would greatly reduce the numerous complaints of consumers, due to the lack of ability on their part to master the reading of the regulation dial, which to the gas man is as simple as noting the time of day. I think also that the change would be of great benefit to the gas companies, as it would do away with the necessity of breaking in new meter readers, and no doubt enable the average meter reader to do his work more rapidly and with absolute accuracy.

Chairman Ritter in closing the reading of the report said: It seems from the answers received that the materials for making recommendations were rather meager. Most of them, as you will notice, are opinions—of course, they are based more or less upon experience; but as the committee did not have time to verify the experiences we did not feel as though we should shoulder the responsibility of fathering recommendations without having time to conduct tests themselves. That will account in a way for what may seem to be an unsatisfactory report.

Discussion.

The President—Gentlemen, you have heard the report of the Committee which certainly evidences a great deal of work on the part of the members. Are there any comments?

Mr. H. L. Doherty—I am considerably interested in the report of the committee. I am sorry they did not come to more definite conclusions than they do; but I think the committee deserve the thanks of the Association for the work they have done. I cannot agree with some of the conclusions that they have reached, and my position on this meter question remains unchanged in spite of the report of the committee. Last year we had some questions in the Question Box and these questions were sent to all the meter manufacturers. The only answers we received to the questions were those supplied by the gas companies. There was no attempt made to answer them by the manufacturers of meters. The questions may have been improperly answered, but the fact remains that the meter manufacturers did not attempt to correct these errors, and the impression has gone abroad, and I for one have that impression, that there is no rational relationship between the parts of meters of the same make, nor is there any rational relationship between meters of different makes and of presumably the same size or the same nominal rating. The committee's report would tend to make us believe that at least the information brought out in last year's Question Box must be very carefully considered. It will not do to jump at conclusions. They also tell us that the meter manufacturers are seeking earnestly to improve their goods and that they are not standing still. If I, for one, am included in those who have made the statement that the meter manufacturers are absolutely standing still, I should have qualified that and want to qualify it now, because I am aware of the fact that changes are going on, but the changes do not necessarily mean improvement; and if the meter manufacturers are seeking earnestly to improve their goods it then seems to me that they are not working along rational lines. I realize, in taking this position, that I know little or nothing about meters. I have simply had my attention called to them as a purchaser, and I am perfectly willing to back down and take off my hat if I am wrong. Mr. Ritter's report gives us, for instance, the relationship between different meters per revolution in capacity. Now, as he does not say what meter manufacturers they are, I do not know whether there is only one manufacturer or whether there are four manufacturers. He says, "Four well known makes." They may all be working under the same shop pattern. Just what relationship there is between the various meter manufacturers I do not know; but they have some sort of a close understanding at least, and they are probably made from the patterns out of one shop. I doubt if these close relationships have been produced independently, and I am inclined to think that they are the result of an understanding existing between these meter manufacturers of a general nature which involves the matter of selling goods to the gas companies. Now it would look from this table as though there were a close relationship at least between the meters turned out by these various shops and by these supposed different makers. But the displacement of the diaphragm is not a thing that has ever been in controversy. We are all satisfied that they use about the same sized diaphragm and would be apt to get about the same displacement. There are other parts of the meter, and each part should be considered in conjunction with its other parts. My experience with meters is that the different parts have no relationship to each other. You start into a tube first having a certain area; then you go through a port hole—you are all familiar with the construction of the ordinary meter—that hole and that tube may be of no relation whatever to each other. Then you go into a channel which has an entirely different area. You go through the various parts and valves and if there is any relationship existing between these various parts and areas I am not clever enough to understand it. It seems to me that there are points in a meter—and I make the statement without any fear of successful contradiction—where the passage of the gas is congested, causing an unnecessary differential pressure on the working parts of the meter, and where the congestion caused by that part could be removed without any expense whatever, or an expense so insignificant that it would not be noticeable or appreciable. In the table referred to, the committee fail to state whether these meters were passing this amount of gas per revolution with the same fall in pressure, and whether we would get the same amount of gas per hour with the same drop in pressure, and also what variation there would be in the pressure during the revolution and where a flicker would occur. Near the close of the committee's report they say "If this Association desires to continue this subject further it should refer it to a representative committee." I would like to know what that qualifying word "representative" means. Now, I want to make my position clear on this subject, and I will say I still hold that there is no rational relationship between the parts of meters, and that the rating of meters is not adapted to our present

needs; that the meter as constructed could be improved without any serious expense to the manufacturer and that the design of the meter would not lead an unprejudiced engineer to believe that it was properly designed; that it has been the result of a little change here and a little change there. If I am wrong about this I am only too glad to apologize. My position is that if the meter manufacturers are earnestly seeking to improve their product they are not going at it in the way it would be done in any ordinary engineering office.

Mr. Donald McDonald, Albany, N. Y.—I want to say, on behalf of the committee, in regard to Mr. Doherty's criticism about the table referred to, that the committee considered, in deference to the time-honored rule of Gas Associations, not to divulge the name of the manufacturer, as it might be considered in the nature of an advertisement. We preferred to number these different makes of meters. They were obtained without any collusion. On behalf of the committee I will say that they are the figures submitted by the various manufacturers, so far as I was able to get the information from them. The tables were received by the committee from them and they are published exactly as I received them and were given to Mr. Ritter and Mr. Shacklette exactly as they came to me. We selected from these tables the capacity that seemed to offer the widest variation and, therefore, covering the greatest average results. There was no collusion about it that I know of.

Mr. Paul Doty—I want to say that I am in hearty sympathy with the work of the committee, and that the committee is to be congratulated upon the work it has done. It is no easy matter to reconcile differences of opinion that may exist regarding the meters of to-day. Some 15 years ago I took up the subject of determining the capacities of meters, in order to establish in my own mind whether there is a relationship between the so-called rating of gas meters and their actual capacity, and I confess, after 15 years of study, I still find that there is something to learn about the meter business. It was with the idea of answering the question that was in last year's Question Box, "What is the capacity of a gas meter?" that I made some experiments in Denver during the past winter. The results of these experiments I have with me, and even with those it is difficult to draw a conclusion. So that to attempt to answer the question to-day, "What is the capacity of a gas meter?" still presents difficulties. I obtained a table some years since from one of the most prominent meter manufacturers in this country, giving me the rating capacity of the meter, and this table gives the capacity at various differentials. For instance, 5-10 differentials, 3-light meter is given in this table as having a capacity of 60 feet; 10-10 having a capacity of 88 feet; 15-10 having a capacity of 106 feet; 20-10 having a capacity of 124 feet. The test dial indicates 2 feet per revolution, which means 18 revolutions of the diaphragm; that is, 9 revolutions per foot, which corresponds to the table which Mr. Ritter has incorporated in the report of the committee, and the figures that Mr. Ritter has given, of course, are easy of verification. For a 5-light meter 5 10 differential gives 80 feet; 10-10 gives 120 feet; 15-10 gives 150 feet; 20-10 gives 172 feet. So you see the question might very naturally be asked, "What is the capacity of the meter?" This table gives the capacity for 10 light sizes, 20-light, 30, 45, 60, and so on. To illustrate a wide difference, take the 200-light meter, for instance. Its capacity at a 5-10 differential gives 920 feet; 10-10 gives 1,300 feet; 15-10 gives 1,668 feet; 20-10 gives 1,807 feet. Again, "What is the capacity of a meter?" Now, the Denver experiments were conducted, first, with the idea of duplicating the results of this table, and we made a series of tests of meters from several well-known meter manufacturers, on 5-10, 10-10, 15-10 and 20-10 differentials, and the results agreed reasonably well with the figures given by the manufacturer which were sent to me in 1898. But that did not answer the question, so I made a further series of experiments to determine what would be the limiting capacity of a meter. Mr. Doherty has pointed out that certain differential fluctuations in lights occur, and it seemed to me that that would be the limiting capacity of the meter, and we could work the meter up to the point where the fluctuation would begin. Beyond that the meter is overloaded. But the experiments show that even then we are striking unusual conditions. For instance, at Denver, with a 3-light meter, we found we could work that meter up to 90 feet per hour, but it required a differential of 9½-10 to do that, the differential being taken between the inlet and outlet openings, and gauges were inserted directly at the opening so that there would be no question of errors in observations. In addition to that, the meter was connected to a bank of lights with piping, and the piping acted as a reservoir, so that we were very near the actual conditions in the use of the meter in one's house, and the meters were tested with gas so that we could observe the actual working conditions. But with this figure—90 feet—before me, am I justified in saying that that is the capacity of a 3-light meter, working as it does under a differential of 9½-10, and can a gas company stand such a differential, and is it safe to use 90 feet in rating the capacity of a 5-light meter? With a 5-light meter we have 152 feet, and that requires a differential of 8-10. With a 10-light meter we have 192 feet, requiring a differential of 8½-10. With a 20-light meter we have 215 feet on a 6-10 differential. With a 30-light meter we have 406 feet on a 7½-10 differential. With a 45-light meter we have 623 feet on a 6½-10 differential. With a 60-light meter we have 750 feet on an 8-10 differential. With an 80-light meter we have 804 feet on a 5½-10 differential. With a 100-light meter we have 955 feet on a 6-10 differential; and with a 150-light meter we have 1,366 feet with a 7-10 differential. These apparently were the limiting capacities of the meter. Beyond that the meter would not work as a gas meter for illuminating uses.

Mr. Hayward—Because of the fluctuation?

Mr. Doty—Yes; so I revised that table to bring it down to what I would consider a safe working capacity, and for that I said that the 3-light meter has a capacity of 65 feet with a differential of 6-10. A 5-light meter has a capacity of 130 feet with a differential of 6-10. Understand, gentlemen, I am not recommending a 6-10 differential for the distribution of gas, but I am simply reporting the facts. The 10-light meter has a capacity of 167 feet with a differential of 7-10. The 20-light meter has a capacity of 315 feet with a differential of 6-10. The 30-light meter has a capacity of 406 feet with a differential of 7½-10. The 45-light meter has a capacity of 559 feet with a differential of 5½-10. The 60-light meter has a capacity of 600 feet with a 6-10 differential. The 80-light meter has a capacity of 733 feet with a differential of 4½-10. The 100-light meter has a capacity of 800 feet with a differential of 5-10, and 150-light meter has a capacity of 1,306 feet with a differential of 5-10. That was for one type of meter. For another type of meter we found other figures. For instance, the 3-light meter will pass 60 feet, and a 5-light 80 feet, and a 10-light 115 feet and so on. As a result of combining these two manufactures I finally evolved this table: That a 3-light meter possessed a working capacity of 75 feet and required a differential of 6-10; a 5-light meter had a capacity of 125 feet with a differential of 6-10; a 10-light meter had a capacity of 180 feet with a differential of 7½-10; a 20-light meter had a capacity of 300 feet with a differential of 7-10; a 30-light meter had a capacity of 450 feet with a differential of 7½-10; a 45-light meter had a capacity of 545 feet with a differential of 7½-10; a 60-light meter had a capacity of 690 feet with a differential of 6½-10; an 80-light meter had a capacity of 709 feet with a differential of 8-10; a 100-light meter had a capacity of 967 feet with a differential of 6½-10; a 150-light meter had a capacity of 1,350 feet with a 7-10 differential; a 200-light meter had a capacity of 1,500 feet at a 7-10 differential. The meter manufacturers will know from their experience how this final Denver table agrees with their experience; and whether they will want to ultimately take this table and say that is the capacity of the meter or not, I am not prepared to say, but I would be sorry if they would do that, because the differential required to drive that meter is very high. But if they will reduce that differential so that it would bring it to within reasonable limits for the gas company perhaps there is something to be gained by us. For instance, if they could give as a capacity of 125 feet for a 5-light meter with a differential of 3-10 instead of 6-10, by changing their present design with very little cost to themselves, by changing the area of the openings and having openings made more nearly uniform and endeavor to establish the relationship which should exist between the various openings, certainly the work of the committee will have been of very great benefit to the gas companies. I then endeavored to plot curves showing the relationship between cost and capacity. The committee apparently steered clear of that proposition, just exactly for what reason I do not know. As no names are mentioned for the different manufacturers there can be no harm in establishing the fact. If the costs increase uniformly with the capacities, then the relationship between cost and capacity would be a straight line. For instance, if they gave us 100 feet capacity for $5 and 200 feet for $10 and 300 feet for $15, then the relationship would be exact. That is, it would be a straight line relationship. Of course, it may be possible in designing meters to give us greatly increased capacities in the larger sizes at lower cost. Whether that is so or not the manufacturers know better than I do. I presume, however, the fact is they manufacture more smaller meters, and so are unable to work their patterns to better advantage than in making few larger sized meters. Perhaps they will give us a straight line diagram. If so, we have gained something there. The line, however, is not a straight line. The costs decrease very uniformly in most of these tests from a 3-light to a 30-light meter. It seems for a 30-light meter the gas company gets the most for its money. Just why that should be so I do not know, but the diagram shows pretty uniformly a decrease in cost for equivalent

capacity from a 3-light meter to a 30-light meter. Then it begins to go up rather gradually to a 60-light meter, but an 80-light meter seems to have no reason for existence. The 80-light meter is a burden the manufacturer should never saddle on a gas company. That is one meter that is out of place, and why it should be constructed I do not know. Our table shows the capacity of a 60-light meter to be 600 feet, with a differential of 6½-10, and an 80-light meter shows a capacity of 709 feet with a differential of 8-10. With the same differential as in the 60-light meter it would have a capacity less than that of a 60-light meter. But as you know 80-light meters are manufactured and the price of the 80-light meter is given in their tables showing the costs. The 80-light meter has no reason that I can now discover for its existence. Undoubtedly the manufacturers will take issue with me and say there is reason for the 80-light meter, but if there is I do not know it. I have also plotted curves of various kinds, showing the speed of rotation of the meters per hour and it gives an irregular line just as Mr. Ritter's tables do, and shows that the larger meter rotates much less rapidly, the capacity per revolution, of course, changing with the size of the meter. But it is a peculiar curve. It has irregularities which would bear out Mr. Doherty's statement that perhaps the meter business is not quite on a rational basis yet, and that there is subject matter for a good paper still on the question of meters. As most of you gentlemen know, I have devoted a great deal of time to the study of meters and have written a number of communications. I presented a paper on meter testing at the Michigan Gas Association some years since. I have made a few notes as to the conditions which a good meter should fulfill. The first condition is accuracy. Now, I am prepared to state from my experience that a gas meter can be depended on for accuracy. The gas meter is a wonderful measuring machine. It is accurate. Condition No. 2 is the permanency of its accuracy of registration. On this point there seems to be very wide variation, and just why there should be is difficult to state, but the meter manufacturers will probably put the burden upon the gas companies, and they may say it is the quality of the gas, or it is the condition under which it is operated that destroys its permanency of accuracy of registration; but that I hold to be condition No. 2. Condition No. 3 is the ability to withstand severe temporary overloads. There is no doubt about the fact that meters are required to work overloaded at times of which we have no knowledge. The meter may be set, for instance, where we think a 5-light one is of sufficient capacity, and additional appliances are put on, suddenly the meter is required to work an overloaded capacity. But the meter should do that without permanently destroying its life or without subjecting it to severe strain. In other words, the meter should be constructed so as to satisfactorily provide for the temporary overload. The fourth condition is the ease of adjustment. That is brought out in Mr. Ritter's report. I would hold that to be one of the points which a good meter should fulfill—ease of adjustment. The next condition is simplicity and durability, The next condition is non-liability to tampering. We find that the meter is tampered with in actual practice, and just how that meter can be made so that it is not easy to be tampered with is a question. Iron cases, of course, have advantages, but we do find with the ordinary tin meter and the handy soldering iron that meters have been tampered with. The next condition, of course, is friction. Just what that friction is, is difficult to explain. Mr. Doherty has pointed out that it is an error in design. That may be true. The manufacturers will know just how to handle the question of friction, but I do hope they will be able to design a meter that will give us capacities which we now find to be the best working capacities with a great deal less pressure absorbed in driving the meter. Of course, the most important condition, all things being equal and quality being uppermost, is that the cost shall be low. I am not bidding for the opportunity to write a paper on meters. There are lots of men who are just as well able and just as capable as I am to do justice to the subject, but I do want to say that the literature on the subject of meters is somewhat meager, and it would be necessary, therefore, for men as individuals to rely upon their own experience very largely. But that there is room for improvement goes without saying, and the improvement must come from the mutual cooperation of the gas man who buys the meter and of the meter man who sells it.

Mr. William McDonald—I have in hand a few remarks that I prepared before I came to this meeting, and after listening to Mr. Doty's remarks I thought possibly they weren't just as appropriate as they might otherwise have been. I want to say here before I proceed with what I have on paper that I almost entirely agree with Mr. Doty in what he has said. My attention has been called to an extract from a letter written by Mr. Doherty to, I believe, the President of the Ohio Gas Light Association. I am also informed that considerable circulation has been given this extract. In this letter Mr. Doherty charges the meter manufacturers generally with being irrational in various ways. To a certain extent this is undoubtedly true, because it has been said that no man is entirely rational, it only being a matter of degree. My purpose in speaking of this subject is, so far as I can, to say that the writer of this letter is more or less mistaken in the views he takes of the irrationality of meter manufacturers and their methods, and I question whether he has given the subject the careful consideration to which it is entitled. While he does not say so, nor do I think he really meant it, yet the extract referred to indirectly accuses the manufacturer of meters of not giving the gas company what it pays for. He also says that meter manufacturing has practically stood still because the purchasers did not know anything about the conditions which prevailed. Is it not reasonable to suppose, considering the fact that meters have been designated by their present names for many years, and by the entire world, that if there had not been some relationship between the name and the size it would have been discovered before? It is not my purpose to go into any technical explanation of meter manufacturing, but to say that probably the meter manufacturer has taken a slightly different view of the rationality of the sizes than has Mr. Doherty, and also a somewhat different view of the question of improvement. I have been in the business of manufacturing meters over 40 years, and during such portion of those years as I have more or less had charge of their manufacture and sale, I can truthfully say that it has been my earnest and constant endeavor to give the purchaser as good an article as it was possible to produce, and at as low a price as was reasonable. To me the principal factors in meter making are to produce a meter accurate in its measurements and capable of registering as large an amount of gas as seemed to be profitable to those using it, and I believe very considerable has been accomplished in this direction and that the purchaser of gas meters is being given to-day far more for his money than ever before. In 1866, 5-light meters were being sold at $13 each, net, and other sizes in proportion. They would not pass at a given pressure more than one-half the gas that the present 5-light meter will pass. Since that time the price of meters has been gradually going down until it is now about one-half what it was then, and, especially with the sizes in general use, the capacity at a given pressure has been going up in about the same proportion. Considering these facts, and the general increase of the price of labor and material, especially labor, is it reasonable to suppose that the meter manufacturer has entirely stood still, and that he has not made some effort to give his customer a better value for his money? Regarding the quality of the goods produced, I desire to say that the manufacturer has done a great deal towards producing a meter that is a perfect measure, and reasonably durable when given the amount of work to perform that its name indicates. He has succeeded in doing away with what was known as shrunken or fallen-in diaphragms, the cause of so much difficulty and dispute between the gas company and its customer. He has succeeded in making tight diaphragms and valves, and by careful attention to the metals in the meter he has succeeded in reducing the friction a very considerable amount, and therefore added to its durability. There is comparatively little complaint nowadays about the accuracy of meters, and it is a fact that if you give the meter a moderate amount of work to do, with gas that is reasonably free from foreign substances, you will get accuracy and durability. When the meter goes out of the factory, it is accurate and can only remain so if it is fairly used, so the meter manufacturer in his calculations has always taken into consideration the speed at which the meter is to run, and I think the more the question is studied the more you will discover that there is a very rational relation between the speed at which the various sizes of meters should be run and the names they are called. The figures given in the report show this to be true, and also, so far as I have been able to obtain them, the figures show a reasonable relation between the size and capacity of meters made by the different manufacturers, all calculated, if you please, on the speed at which the meter ought to run. There have been scores of inventions made in the meter line. I have personally examined, I presume, almost every patent that has been issued in connection with this business, being constantly on the lookout for something that seemed to be a real improvement. Many of the so-called inventions proved to be merely old devices in a new form. Many were ingenious, I might say unnecessarily ingenious, and I think the purchasers of meters should mark down a long score of the meter men for saving him much trouble in not allowing devices to be put on the market which, while ingenious, were of no particular use. In fact, it has always seemed to be exceedingly difficult to find anything new, the merit of which recommended itself to all purchasers. As a sample of this difficulty take the standard meter unions. After

10 years of effort to get gas companies to adopt these unions, meter factories are regularly producing three sizes of 5-light unions. I do not say that, under present and possibly coming conditions, the sizes of meters are altogether as rational as they might be, but I do say that, when the amount of work that the meter is fairly capable of performing is taken into consideration together with the price at which it is sold, as compared with the cost of its manufacture, the meter is entirely and altogether rational. As a meter manufacturer I have no desire to stand in the way of the car of progress, nor do I expect to be crushed by its revolving wheels, but I do say, after long experience and the most careful study of all conditions that surround the manufacture of meters, that it will be well to consider carefully before radical changes are made from the present conditions under which meters are made and sold. (Applause.)

Mr. Doherty—As Mr. McDonald has directed his remarks primarily towards me, I would like to have an opportunity to reply and to explain my position—not apologize for it. The letter to which Mr. McDonald refers was written as a private communicrtion to our Secretary, Mr. Jones. At the time of its writing I had no idea that anybody would see it but Mr. Jones. Perhaps it is too bad that that letter has been circulated freely. But there is nothing in that letter that does not express my real convictions. There is such a thing as a man having beliefs, which are so strong that he is no more responsible for than he is for the color of his eyes or his hair, and that letter expresses my beliefs. Now, Mr. McDonald takes a position here which I cannot quite follow. I get up and make the statement that no rational relationship exists regarding the parts of meters. Mr. Doty gets up and shows that they do not exist, and then Mr. McDonald gets up and says that he agrees with Mr. Doty, but says they are entirely rational. If he will elect which position he will take I will be very glad to meet him on either ground, but I cannot meet him on all of them, inconsistent as they are. I believe that Mr. McDonald is in the position of claiming that his meter, at least, is thoroughly rational. Don't you, Mr. McDonald?

Mr. McDonald—I think so.

Mr. Doherty—All right. Mr. McDonald is mistaken or else I am mistaken. I say it is not. If there is any way of referring this to a proper arbitration board I will take the responsibility of demonstrating to Mr. McDonald that his meter is not rational. I will also take the responsibility of demonstrating to Mr. McDonald that his meter can be improved without material expense to himself. There may be some expense in changing, but if it had been properly designed originally there would have been no expense to him. We have gotten to the point where one is on one side of the fence and the other is on the other side of the fence, and there ought to be some way to demonstrate and determine which of us is right or which of us is wrong in degree, if we are both wrong. I am not here trying to produce a fight with the meter manufacturers, and I am not here trying to sustain any position that I may have erroneously taken. I am here simply looking for the truth. If I can get that from Mr. McDonald or anybody else, I am only too glad to get it, and I would sooner learn in time what is right than to try and maintain a false position. If Mr. McDonald has no other way of suggesting how we can demonstrate which of us is right, I will ask him to sell me one of each size of his 3, 5, 10, 20, 30 and 45-light meters; to send me whatever meter he wishes, if he makes some meter that is rational and that I have not yet seen—to send me that meter and I will either agree to furnish Mr. McDonald with a written statement of some parts which do not bear a rational relationship to other parts, or I will try to get Mr. McDonald to say it is so that the meter is not rational in its parts. But as I said before, gentlemen, I am here taking a certain position because it is forced upon me by condition, and if I am wrong I would prefer to learn rather than to maintain an opinion I have expressed, if it is an erroneous one.

Mr. William McDonald—I, of course, regret that Mr. Doherty makes this a personal matter. I do not know that he intends it, but I tried to say, in the few brief words I did say, that Mr. Doherty and I look upon this subject from an entirely different point of view. I think he will find this is in the paper which I read, and I still am of the same opinion that the difficulty between Mr. Doherty and myself on the subject of meters is that he takes one view of the subject and I take an entirely different one. My contention is this—and I want to make it clear if I can—that what the meter man puts on his meter to-day is the right thing to put there; that if you use the meter at what he says it is to be used for, you will not have any trouble such as he complains about. That is to say, we say a 3-light meter is capable of passing and taking care of 18 feet per hour, a 5-light meter 30 feet per hour, a 10-light meter 60 feet per hour, and a 20-light meter 120 feet. I firmly believe, in putting meters in for use they ought not to be as far as is generally known, required to register gas beyond those amounts that are named for them. Of course, they are made so that they are able to take care of any unusual temporary demand that may be put upon them, but the idea of running a meter to go up to as high a speed as possible in view of the meter manufacturers' statement as to capacity as entirely and altogether wrong. It is pursuing a wrong idea. The whole idea is wrong. The meter should be used moderately. If it is used moderately it is an accurate and durable instrument. If it is used to its greatest and utmost capacity it is not anything. It does its work possibly as well as it can do it, but it does not do it accurately or well or continuously when run to its utmost capacity. I might go a step further and say that I do not believe the people who have been considering the meter subject, outside of the meter manufacturers, have taken into consideration the wear and tear on the meter. The moment you put the meter up to a high speed it deteriorates very rapidly, and it will be but a very short time before it becomes inaccurate, and the inaccuracy generally bears against the gas company by reason of the wear and tear on the meter. Now, the meter manufacturer is trying to give the gas company something that measures the gas and that records all the consumer uses, and I contend that this whole matter is on a wrong basis from the meter manufacturer's standpoint, as advocated by Mr. Doherty. It may be that we will be educated differently some day, but we have studied this matter hard. We have given it a great deal of attention, and this attempt to push the amount of gas a meter will pass up to a high standard or volumetric amount in my opinion is a great mistake.

Mr. Doherty—I do not like to be on the floor all the time, but I am glad now that I know what the capacity of a meter is. I did not know before. As I understood Mr. McDonald, we are to multiply the light capacity by 6.

Mr. McDonald—That is what the meter says, Mr. Doherty.

Mr. Doherty—No; the meter says so many lights, and you assume that is 6 cubic feet.

Mr. McDonald—Yes; and everything that has been written on this subject and all the data we have show that that means 6 feet to the light; everybody knows that.

Mr. Doherty—Do you agree, Mr. Doty, that it means 6 feet or 5 feet?

Mr. Doty—I have heard the statement before that Mr. McDonald has made that 6 feet per rate of light is the normal capacity of the meter, but I hardly think that Mr. McDonald himself will take the position, because the meter is changing. As Mr. McDonald has said, we are getting more for our money per capacity in the smaller sized meters than we formerly got. In just a moment, Mr. Doherty, I will prepare a table on the basis of a 6-foot capacity per rate of light and see whether the speed of rotation of the different sized meters will be uniform. I do not think it will be.

Mr. Doherty—While you are preparing the table, Mr. Doty, I will go on and say just a word or two. I cannot imagine any better way to increase the life of a meter than as recommended by Mr. McDonald; that is, to set the meter so that it will not be taxed over 6 feet per rated light, unless it would be to leave it in the warehouse. Why we should use a meter so far below a reasonable capacity for the bulk it occupies I do not see, and I do not see why any rule that pertains to other branches of engineering, regarding speed, etc., should not obtain with meter manufacturers in the construction and use of meters. If we can use a dry valve in other branches of engineering at a certain speed, I think that ought to hold good with the meter manufacturer. Mr. McDonald continually refers to the limiting capacity of the meter. Now, I would like to know—and I ask this in good faith, because I do not know now—what the meter manufacturer considers the limiting capacity of a meter, where is its limit, and what causes that limit? I can conceive of several things that would cause a limit. One would be the differential pressure, another would be speed of the wearing parts, and from what has been said I must conclude that they are only looking towards the speed of the wearing parts. Now, after they do that they should build their meters so that the speed which they consider permissible would require the least possible differential pressure on the working parts of the meter. Now, I want to know from Mr. McDonald what limits the capacity and what means they take to keep that differential pressure at its minimum on the wearing parts of the meter?

Mr. McDonald—I do not really understand Mr. Doherty's question. I cannot answer it as he puts it.

Mr. Doherty—Mr. McDonald has made the statement that you must not drive a meter beyond some certain point. He does not tell us what that point is, and he does not tell us what fixes that point. Now, all I want him to do is to tell us what the limiting speed is and what limits it? What limits the capacity of a meter? I want him to tell us that, and then I want him to tell us what means they take for insuring to us

the least differential pressure on the working parts of the meter for that limiting speed, whatever it is, that he recommends.

Mr. McDonald—I will say, Mr. President, that I do not think the meter man looks at it from that view at all. I cannot understand entirely what Mr. Doherty is driving at. Each meter of a certain size, in my opinion, is capable of passing about a certain amount of gas. The fact is, that it comes out of the factory very nearly uniform. It will not vary very much. If we were to go into a technical description of meter making, Mr. Doherty knows that the most infinitesimal amount of oil on the valve of a meter will change its volumetric capacity quite a little; that it is subject to all these very small things that sometimes change its volumetric capacity quite materially, and which it would be almost impossible to entirely and altogether overcome. But the meter manufacturer tries to have the meter in a condition when it goes out of his factory that it will do the best work with as little friction as possible. He bears in mind, gentlemen, that the gas meter works under the most infinitesimal pressure of almost anything in this world. When you are talking about a 1-10, 2-10 and 3-10 pressure, you are talking about a very slight amount. No science can be pursued to the point where it comes to an end, and any man who gives the subject thought will find that there is a place to which he cannot attain in the matter of exactness, and it is so in meter manufacturing when you come down to 1-10, 2-10 and 3-10 loss of pressure.

Mr. Doherty—I think Mr. McDonald ought to more clearly define his position. He keeps saying that the meter manufacturers' position is so-and-so, but he does not tell us what that is.

Mr. McDonald—I do not know.

Mr. Doherty—You are a meter manufacturer and ought to know.

Mr. McDonald—Oh, yes; but I do not know. I cannot tell you.

Mr. Doherty—There is not very much use in carrying on this discussion if you take that view of it.

Mr. Doty—Mr. President, just to have it on the record I would like to say that I have prepared a table based upon the rate of capacity which Mr. McDonald has given us of 6 cubic feet capacity per rated light. A 3-light meter would have 18 feet capacity on that basis. The revolutions per foot for a 3-light meter are 9.

Mr. Donald McDonald, Albany, N. Y.—8, Mr. Doty; mostly 8.

Mr. Doty—I think this table of Mr. Ritter's shows 9.

Mr. McDonald—It should be 8.

Mr. Doty—It makes your case so much worse.

Mr. McDonald—All right, it is 8.

Mr. Doty—I will first read the revolutions so that if Mr. McDonald has any objections to them, he can state them.

A 3-light meter has	9	revolutions	per	foot;		
5	"	"	"	6	"	"
10	"	"	"	3 6-10	"	"
20	"	"	"	2	"	"
30	"	"	"	1 4-10	"	"
45	"	"	"	9-10	"	"
60	"	"	"	7-10	"	"
80	"	"	"	4-10	"	"
100	"	"	"	35-100	"	"
150	"	"	"	25-100	"	"
200	"	"	"	20-100	"	"

Upon that basis, remembering that 6 feet is given as the rated capacity of a meter the revolutions per hour are as follows:

Three-light meter 162; 5-light meter 180; 10-light meter 216; 20-light meter 240; 30-light meter 252; 45-light meter 243; 60-light meter 252; 80 light meter 192; 100-light meter 215; 150-light meter 225; 200-light meter 240.

You will note, gentlemen, the variation is from 162 revolutions per hour for a 3-light meter to 252 revolutions per hour for a 30-light meter or a 60-light meter. The difference is about 90 revolutions per hour, which would make nearly 60 per cent. more revolutions for the 30-light and the 60-light meters as compared with the 3-light meter, which is 162 revolutions. I believe Mr. McDonald is not doing justice to himself in giving such a capacity rating for 3, 5 and 10-light meters. I know they are well worth a great deal more than 6 feet per rate of light, and Mr. McDonald knows it. So that the old fashioned rating of 6 feet per rate of light is obsolete.

Mr. Wm. McDonald—It has always been calculated by meter manufacturers that the smaller meters did more work proportionately and were able to do more work proportionately than the larger ones. I think that can be stated without contradiction; that they have almost always allowed that.

Mr. Doty—Then I again ask, Mr. McDonald, "What is the rated capacity of a gas meter?" (Laughter.)

Mr. McDonald—I do not know. (Renewed laughter.)

Mr. Ritter—Before we drop this subject entirely I should like to say that the basic principle upon which a meter should be built is diaphragm displacement and revolutions, but there are a great many influences that contribute to the durability of a meter that are not contained in the meter itself and are not matters of record. I do not know just exactly what all of these influences are, but I should say that the character of the gas, the temperature at which it is registered or temperature at the location of the meter, all contribute very largely to its life and durability. Some tests were made of 100 new meters about 3 years ago. That was a regular routine test. One of these meters was found to become non-registering in 9 months, having passed only about 15,000 cubic feet of gas. Another representing the opposite extreme was O.K. 43 months after having passed 185,000 cubic feet of gas. Between these two extremes we found almost every condition that you could think of.

Mr. Doherty—Mr. Ritter did not answer my question regarding a "represeutative" committee to be appointed by this Association to carry this work on further. I do not know what that word means.

Mr. Ritter—I should like to say, Mr. Chairman, that my interpretation of a "representative" committee is a committee that will represent both the meter men and the gas men.

Mr. Butterworth—That is what this committee did, Mr. Ritter. Aren't you a gas man?

Mr. Doherty—Mr. Chairman, my idea is that this work should not be dropped. We have meter men and gas men here. The gas men are perfectly willing to debate the subject. I have been trying to find out what the limiting capacity feature of a meter is. Mr. McDonald is a meter manufacturer, and yet he tells me that he does not know. Now, at the last meeting of the Ohio Gas Light Association certain data were brought out about meters, and that probably provoked me to write the letter that I did, and which Mr. McDonald objects to. The matter was discussed on the floor of the convention. Afterwards criticisms reached my ears from meter manufacturers. Now, this is not anything that I care to carry on in that way. I prefer to come right out in the open and say what I have to say, and I would be only too glad to have the meter manufacturers do the same. You gentlemen have heard the arguments we have had here. I hope you realize the object which prompts those of us who have taken the position that the meter manufacturer was not entirely rational. We are not trying to dodge the issue; we are here reiterating our position, and it seems to me that now is the time, if we are wrong, to have the error of our way pointed out to us, and I am here still trying to find out what is the limiting capacity of a meter, so that I can compare it with the limiting capacity of other similar mechanisms put out by other manufacturers, in order that I can carry this work of investigation still further. The committee, I hope, will be continued. I do not see but that it is a "representative" committee, and I want to assure the meter manufacturers that I am not trying to bring any unnecessary criticism upon them, but as a gas man, am simply trying to get the most I can legitimately for my money—not necessarily the most capacity; but when I get a meter having the least differential pressure and having the greatest capacity, it is reasonable to suppose that that meter will carry a portion of that maximum capacity more readily and for a longer period of time without repairs than a meter such as we are getting to-day. The way it is now in many cases, and especially where the instantaneous water heater is in use, we would be required to put in a 20-light meter to take care of the volume of gas consumed. For instance, in Madison, Wis., an instantaneous water heater may yield a revenue per year of $3.60, and yet, according to Mr. McDonald's rule for meters, we would have to put in a 20-light meter to take care of that instantaneous water heater. We cannot afford to do it. We can better afford to stand some repairs on the meter rather than to have that excessive investment. After all, the gas business is a business where we have to watch with the utmost care and scrutiny our investments. Everyone of you will find on a close analysis of your expenses that your fixed expenses are more than your output expenses. Take, for example, interest on investment, depreciation, insurance, and things of that sort, and they will exceed your output expenses. But I want to see the committee continued and go into this subject further.

Mr. Wm. McDonald—I hope Mr. Doherty does not misunderstand me. There is no question that any meter, especially in the smaller sizes, up to 20 and 30-light, will easily take care of three times the named capacity in a pressure like a water heater, and they are intended to do it, but they are not intended or calculated to keep that speed up all the time.

Mr. Doherty—It comes back again, Mr. President, to the question, "What is the capacity of a meter?" and can the manufacturers furnish us a safe working table of meter capacities, and have they ever done it?

Mr. Malone—I would like to ask if the electric meter manufacturers

place a limit on the capacity of their meters? I do not think they know.

Mr. Stone—Mr. President, I cannot answer that question, but it seems to me it is rather unfortunate that the discussion has gone along on the lines it has, within the last few minutes at least. It seems to me it would be better to refer the whole matter back to the committee, letting them take up this subject of differences between Mr. Doherty and the gas meter users on the one side and the gas meter manufacturers on the other. I have no doubt in my mind that if any improvement can be suggested to the meter manufacturer by which he can increase the capacity of his meter, say anywhere from 25 to 30 per cent., without increasing the cost of manufacture, or without making any radical change in the meter beyond possibly changing some valves, or some minor points in the construction of it, that the meter manufacturer would be very glad to do it. I think they are honest in their endeavor to give the buyer the best possible value for his money. They possibly don't see where they could make these improvements. On the other hand, the buyer, or the man who uses the meter, wants to get just as large a meter—that is a meter that will register as large a quantity of gas as he can and not wear out. He wants to get that kind of a meter for his money which will best serve his purpose. It occurs to me it would be better to refer the matter back to the committee and let Mr. Doherty take a gas meter and determine where the points of weakness are, if he wishes to do so, and explain to the committee wherein the meter is weak, wherein the design may be improved, thus giving it a longer life and better service, and still register as accurately and as straight as it does to-day, and then let the committee take it up with the meter manufacturers, and see what is the reason they could not improve their meters by making the changes which Mr. Doherty suggests. Let the two get together in that way, and at the next meeting let the committee report the results of their investigations. Let them report what they consider a safe estimate on the capacity of the different sized meters. I think that would be better, and we could all get at the real facts better in that way than by arguing the matter as we have on the floor of the convention.

Mr. Donald McDonald, Albany, N. Y.—As a member of this committee I want to say one word more. I agree with Mr. Stone. I think the discussion is getting too acrimonious. At the same time there are two points in all of this discussion which we cannot overlook. The first is: That the committee, after carefully investigating this matter, and after conferring among themselves, come to one conclusion on which they all agree. Now, if Mr. Doherty will agree to that, perhaps we can begin to make progress, but he has to agree to it before we go any further. The first proposition is that "the capacity of a meter is the product of the capacity per revolution multiplied by a desirable and economic number of revolutions per hour." Now, the meter manufacturer will tell you exactly what the capacity of a meter revolution is, but he cannot tell you what the desirable and economic number of revolutions per hour is, because conditions in the gas business are continually changing, and have been changing for a great many years. They are changing very much more rapidly to-day than they were some years ago. The gas men should first come into honest accord with the meter men in trying to determine what the desirable and economic number of revolutions per hour is, and then the meter men can answer your question as to what the limitation of the meter is. That is where we are. To continue the committee without first arriving at a point from which we may start in attempting to progress in this matter, is, it seems to me, a futile undertaking.

Mr. Stone—It seems to me that Mr. McDonald's point is well taken. We cannot go back of that. It is simply a question of determining the number of revolutions at which the meter can travel safely. That is, the number at which it can travel and not wear out in a reasonable length of time. And also the difference in pressure at which the user of the meter is willing to concede to the manufacturer, as being the limit at which it will work. For instance, if we demand a meter at 3-10 differential, then let us set the meter at 3-10 and see it is not required to exceed that. If we think a meter will travel a given number of revolutions under given conditions, let us arrive at that result and have it so stated. I think a committee would be able to determine such a question, but let us come to some basis whereby we can reach an amicable conclusion in the matter. Let us come to some basis that would be for the benefit of both manufacturer and user of the meter.

Mr. Doherty—I do not know whether Mr. McDonald expected an answer to his statement or not. I would say, Mr. McDonald, that I am simply in the position of one purchaser of meters. I am not trying to insist on the committee taking any particular stand one way or the other. I am not attempting to say what position they should take; but as a member of the Association, I feel it right to call attension to certain things that I consider pertinent in meter manufacture and operation. Now, if we were to assume the position that you assume we would have to assume that it is that feature alone which limits the capacity of a meter and I hold that is not the feature that limits the capacity of a meter. A great many things may limit it. You cannot operate a meter to the point where it will cause a flickering of the lights. And that does not necessarily have anything to do with the displacement of your diaphragm. On the other hand, it is unsafe to work a meter at a considerable differential pressure, and that has nothing to do with the displacement of your diaphragm. If you include the valves and openings through which the gas must travel you are limited by the point of greatest congestion in your meter regardless of the size of your diaphragm. So I simply hold that is not the one basic principle by which you should govern the size of the meter. It is governed by many things, and that is for the committee to determine. I think they have done some very excellent work, and I would like to see the committee continued. I think it is a "representative" committee. It is a committee representing the purchaser and the manufacturer, and I would move, Mr. Chairman, that the committee be continued, and that the matter be referred back to them for further investigation. [Seconded by Mr. Stone.]

The President—That would seem the proper thing to do. There seems to be two opposite positions here—both, no doubt, honestly taken; but there ought to be some method of arriving at a definite conclusion. The question of a meter at its top speed may be considered on one side, on the other side having in mind the longest life and the best use of the meter. I think that about defines the situation. The question is to arrive at the proper point that may be established and adopted in the meter which best serves the purpose for which it is designed and sold and used. As we all know, many new problems have been presented to the gas companies in recent years. New conditions prevail in the use of gas, and consequently in its measurement. The conditions are new on both sides. The committee has done very excellent work in endeavoring to establish a starting point, and it will probably be able to find a satisfactory conclusion to all these problems. [Motion adopted.]

The President—It is understood, of course, that the same committee is to continue the work. (To be Continued.)

The Development of the Modern Gas Plant.

[A paper read by Mr. Thomas D. Miller, New Orleans, La., at the Dallas meeting of the Southwestern Gas, Electric and Street Railway Association.]

"And the Lord said let there be light, and there was light;" but the light the Lord gave to the world was an intermittent one, and the world was bathed in sunshine for 12 hours and plunged into darkness for 12 hours.

It must have been way back of the Dark Ages that the mind of man began to deliberate over this condition, and realized that 8 hours of work, 8 hours of play and 8 hours of sleep constituted a good division of the 24 hours; that if 8 hours of daylight were devoted to work and 8 hours of darkness devoted to sleep, it naturally left 4 hours of daylight and 4 hours of darkness for recreation. To convert these 4 hours of darknass into daylight must have been the first incentive to the production of artificial light. That it was accomplished centuries ago the museums of the world testify. The fire light of the savage, the torch, the flambeau, the tallow dip, the candle, the kerosene light, the gas jet, the electric light and the acetylene light all mark epochs in the development of the artificial lights of the world, and not until gas was discovered had there a light been in use whose supply could be distributed from a central station, and one man, or one set of men, as it were, do the "snuffing" and "dipping" for a whole community. It has been said that he who makes two blades of grass grow where one formerly grew is a benefactor to mankind, and he who makes one hour of light out of an hour of darkness is equally a benefactor to mankind. Crime fears the light, and it was argued many years ago that one street lamp was equivalent to two policemen—in fact, the one street lamp will serve to make two policemen keep busy, because where there was no street light the policeman could not be observed when he took a quiet snooze and his absence was not noted. At one time he was required to carry a lantern and at regular intervals call out the hour of the night and "All is well." That there was a general wakening of the spirit of advancement, invention and improvement about the time the gas works were begun to be installed there is no question. In this day, when so many wonders are appearing constantly, the tendency is to lose sight of the equally wonderful discoveries and inventions of a century or more ago: Watt, Fulton, Stevenson, Murdock, Whitney, Howe, and even Morse, are being overshadowed by the wonderful inventions of Thomson, Brush, Westinghouse, Edison, Tesla, Marconi and others, and yet in their day and age the achievements of the former were looked upon with as much wonder by the people of that time as these later-day wizards are regarded by us; and there is no doubt but that they were as great.

The original discoverer of the gas giving properties of coal is, like many of the ideals of the past, likely to be questioned and perhaps, with some decree of credence, the right to this credit may be assailed. In a recent paper read before the Western Gas Association, Mr. John McIlhenny, of Philadelphia, said:

"I like to think of good, old Rev. John Clayton, Dean of Kildare, as the real inventor of the gas works. Some authorities dispute the claims that posterity makes for him, but all agree that this was the first real recorded experiment. One historian says that when Dr. Clayton was sitting by his sea coal fire, he doubtless saw bright shoots of flame with hissing noises or pressure rise from the burning lumps of coal. Then, as the story goes, he filled the bowl of his clay pipe with fine coal, put on the end or over the bowl a luting of clay, which was inserted in the fire, and the gas resulting was lit at the end of the stem. This was the first gas retort. He went on making it on a larger scale, collecting the gas in bladders. Behold the first gasholder! This must have been sometime between 1730 and 1740, for, in 1739, he wrote to the Hon.

Robert Boyle an account of his experiments, which Boyle afterwards, with his own comments, sent to the Royal Society of London, of which he was a member.

"But little attention after this seems to have been given to the business until 1790, when Mr. William Murdock appears. He was familiar with the writings of Clayton and Boyle and was a practical man, a great worker and a member of the Royal Society. He is unquestionably the father of the commercial gas business of to-day. Mr. Samuel Clegg invented purification by lime and the hydraulic main, the latter being the same as to-day, and was an immense step forward.

"It was not till 1802 and 1803 that any real attempt was made to introduce the business to the public by Mr. Murdock. This was 100 years ago, and it has occurred to me that when so many events are having their centennial celebrations it might be well for the gas man to have one of his own, to show the progress our business has made in that time.

"While Mr. Murdoch and Mr. Winsor were working manfully to introduce and establish the business, they met with very poor success. At that time men's minds were not receptive for new things. On the contrary, innovations were ridiculed and resented, and gas has had a peculiarly hard road to travel, as the people and the lawmakers professed to believe that it constituted a very dangerous element, and sooner or later would blow up the towns and places and kill everybody where it was introduced.

"An event happened in 1814 that was a great gas boom. This year the allied powers met in London to celebrate the overthrow of Napoleon, and all writers on the subject speak with enthusiasm of the new light, seen for the first time no doubt, by most of the thousands who gathered in and around St. James' Park, where a pagoda was erected in which were 10,000 gas lights which, by some contrivance, were all lighted at once. After this the attitude of the public and the newspapers changed at once, and the latter were unstinted in their praise for the gas light. They said its brightness was as clear as the summer noon, but soft and beautiful, and, among the many things said besides, that the beauty and loveliness of women were greatly enhanced by the soft but brilliant rays. The large retinues of men and women who accompanied the representatives of the Allies carried back with them to their own countries the accounts of the wonderful illumination by the new light, and to a considerable extent gave it a better position in the public confidence than it ever had before."

From that day to the present time there has been a steady improvement in the methods and appliances for the manufacture, distribution, sale and use of illuminating gas. Inventors have constantly been at work perfecting furnaces to supply the heat to distil the gas from the coal, and the storage and distribution of the gas through pipes required great ingenuity. The first pipes used were old gun barrels joined together. The measurement of the gas wae a perplexing problem, and the burners for its consumption absorbed considerable attention then and have done so to this day.

A means of measuring gas to the consumer was needed, as everyone then in the business saw and felt. The meter had not come, and charging so much by the hour per burner would not do. Disappointment, bankruptcy, and exceedingly high prices were the rule before advent of the meter. The invention of the gas meter saved the gas companies.

The system of charging a flat rate, as it is now called, of so much per burner per month, per quarter or per year, was extremely unsatisfactory. It furnished, as you all know, too many opportunities for fraud and injustice, and it was necessary for the gas companies to charge a large margin of profit to cover just such contingencies.

One of the first meters invented was made of bladders, which were so arranged that one bladder would be filled with gas from the holder, and in expanding would force the gas out from another one already filled, and a valve system would shift the responsibility from one to the other, and thereby furnish a steady supply. This shifting of the valves by suitable clockwork registered the number of times each bladder had filled and emptied. These bladders, owing to the properties of gas, soon becane dried and cracked, and were finally abandoned for improved devices. The wet and dry meters were the final results of experiments on these lines.

The invention of the gas meter as a measuring device of constancy and reliability was the one great stride to the successful launching of the gas business as it is to-day. Of course, a great many improvements had to be made in the character of construction and design of the generating apparatus of the gas works, as well as the means of purifying the gas.

The storage holder caused considerable uneasiness when first erected, and the Common Council passed ordinances requiring that the "gas meter" should be inclosed in a substantial brick building, so that in case of an explosion the community would be protected from injury by the building. The Honorable Members of the Council were surprised and incredulous when informed that the contents of the gasometer could not explode until mixed with air, and they were dumbfounded when a pick point was driven through the side of the holder and a torch applied to the hole resulted in nothing more than the emission of a flame from the opening. Even to-day thousands of our citizens hold much the same beliefs.

It is not my purpose to enter into a detailed discussion of these steps of improvement in the development of the modern gas plant, as that has been too thoroughly and completely gone over in the annals of the business and the records of the various Gas Associations.

Water Gas—Professor T. S. C. Lowe was employed by the Federal Government, during the Civil War, in the balloon service of the army, and in his experiments to produce large quantities of hydrogen for use in balloons he invented, as the results of his experiments, what is commonly known as the water gas process. The process is substantially the disintegration of steam by a bed of superheated carbon, producing carbonic oxide and hydrogen. The blue or non-illuminating gas thus produced possesses very inferior heating qualities, being only about 300 B.T.U. to the cubic foot, while illuminating gas possesses from 650 to 750 B.T.U. to the cubic foot; but when the vapors of oil are introduced there is produced the commercial carburetted water gas of to-day, about equal in calorific value to coal gas.

The development of the modern gas plant, considered in its broadest meaning, applies not only to the manufacturing and distribution, but also to the organization and machinery of the office for carrying on the business.

Until about a quarter of a century ago the gas business was run by men who had a secret art, and only the initiated were allowed to know the mysteries of the gas house; they were the czars of the lighting world. The profits of the business were regarded as satisfactory, and still the operation of that business was, as viewed by the light of to-day, excessively expensive and almost extravagant. This is very forcibly impressed on one whom, when reminded of the fact that small plants are to-day selling gas for a profit and at a price that is below the actual cost of the gas of many of the larger cities 35 years ago. This is not due wholly to the reduction in cost of materials or to the lower wages paid to the employees, but is due to the improved methods and more thorough understanding of the processes necessary to obtain results. The most powerful influences in bringing about this wonderful change has been the educational work of the various Gas Associations of this country, and Europe.

The throwing down of the bars of secrecy and publishing to the world the fact that there was no reason for occultism in the conduct of the business were great strides in the right direction. The advent of the electric light placed a worthy competitor in the field and literally woke up the gas men of the country. Some realized the importance of this new light and began to "get right;" others persisted and insisted that it could not be sold on a commercial basis at a profit, and a thousand and one other reasons were offered to allay the fears of investors in gas properties. Notwithstanding this the electric light kept moving steadily on, like a ship of state sailing into harbor—and she ought to have moved with ease and grace, because she had plenty of water to sail. The predictions that were made early in the history of the electric light have, some of them, become true—that electric light could not be sold on the same basis as gas to produce the same revenue; and while this is true, it is not due to the fact that electric light has not been cheapened, because it has, but is due to the very great cheapening of gas for light. This brings us now to the invention of Dr. Welsbach, inventor of the incandescent gas light.

The original cockspur gas jet, burning a 14-candle power gas, produced about 2 candles of light per cubic foot of gas consumed per hour, or on 5 feet per hour, which is the standard consumption per hour and basis to all reference to candle power of gas, would produce 10 candles of light. As improvements were made, the quality of the gas was raised, and 18-candle gas, with an ordinary jet, produces from 3½ to 4 candles per foot of gas consumed per hour. The common Argand burner produces less than this. The Sugg Standard English Argand produces 4 to 4½ candles per foot, and the Siemens and Lungren lamps increase this yield of light to about 10 candles of light per cubic foot consumed per hour. The Welsbach light, when first put on the market, gave a fraction over 12 candles of light per foot of gas consumed per hour, while the Welsbach single burner of to-day gives something over 20 candles of light per cubic foot of gas consumed, and the inclosed incandescent gas lamp, known as the "gas arc," will give as high as 25 and sometimes 30 candles of light per cubic foot of gas consumed per hour.

The introduction of the incandescent gas burner resulted in increasing the light giving power of the gas four-fold; the result was that gas bills, where the Welsbach burner was introduced, were cut into half and the light doubled. This made it necessary for the gas man to find some other market for his product. The constant cheapening of the commodity made it possible for its introduction for other purposes than that of lighting, and to-day, in addition to lighting, it is being used in thousands and thousands of homes for cooking and heating in various forms, and manufacturing in ways too numerous to mention in a paper like this.

The gas engine, which has been known and used for a great many years, is rapidly coming into prominence because of the great improvement in perfecting these motors, and I have no doubt that the day is not far distant when the greater part of the electric light will be generated by gas engines, and generated more economically than it is to-day with the steam engine. The steam engine uses effectively only about 10 per cent. of the calorific value of the fuel consumed under the boiler; the gas engine of to-day consumes about 12,000 B.T.U. per hour per horse power. The mechanical equivalent of one horse power per hour in heat units is 2,545, or a percentage of efficiency for the gas engine of more than double that of the steam engine. When you consider the high state of perfection of the steam engine of to-day, and the

great dearth of accurate scientific knowledge of the gas engine, you can form some slight conception of the future possibilities of the gas engine.

The gas plant of to-day was evolved from an unprofitable scientific and mechanical process to a scientific and commercially profitable business. Scientific in the various departments of producing and handling the gas and artistically commercial in the promotion of the enterprise and the sale of the gas and other utilitarian products.

[Concluded from Page 771.]

Central Station Economy.

By Mr. F. H. Davies, in *Elec. Engr.*

Feed water in many installations accounts for a good portion of the works' costs, and is frequently the source of waste. In most cases, if a boiler has to be repaired or cleaned, it is blown right down into the sump and all the water thus lost, but this is not at all necessary if the blowing down arrangements are properly designed and used. There should be a main blow down pipe, into which all the boiler branches lead, having a valve in it between the last boiler and the sump. When a boiler is to be emptied the main valve should first be shut, the valve in the blow down pipe of an empty boiler and its safety valve opened, and the boiler then blown down. This will result in the saving of practically 50 per cent. of the water, as this amount will naturally flow into the empty boiler before the water levels become even. The other 50 per cent. must be lost, but the saving is considerable, especially when large boilers are used.

The losses that occur in steam pipe work account for a large proportion of the total. They are due to four causes—leaky joints, long runs, bad covering and inefficient steam traps. Persistently leaky joints cannot be cured except by some structural alteration in the piping. Practical experience proves that, although some jointing materials are better than others, the best will not cure a defect arising from bad workmanship, and for this reason it is imperative that pipework should be of the best quality and erected in the most careful manner possible, with due provision for staying and expansion. The causes of leaky joints are badly faced flanges, pipework that being too short has had to be pulled together on the last joint, inefficient expansion and draining apparatus. If flanges are badly faced, or do not meet truly all around, the cure is obvious—they must be faced up properly; experiments with jointing materials are waste of time and money. If the work has been pulled together in a straight length where there is no allowance for expansion, there are two remedies open—either to provide an expansion bend or joint, which is costly, or, preferably, to insert a carefully shaped and faced distance piece between the two open flanges. Should a certain length of pipe persistently give trouble with all or several of its joints, this points generally to expansion or water troubles, and should be carefully investigated; it may be that the staying is too tight and does not allow the contraction and expansion to be taken up on bends, as is generally the case. If this is so, an expansion piece must be inserted, preferably a U-shaped piece, not a joint, as the latter always leak. This will be found, in the long run, the cheapest remedy.

Should the trouble be located as due to water, it means that the draining arrangements are inefficient or not properly used, and the best way to set about a cure will probably be to install an extra drain pipe at some low part of the range, or to overhaul the steam traps. These latter are often very troublesome chiefly owing to inattention. They are too frequently stowed away in practically inaccessible places, and there left to chance their luck, year in and year out, with little or no inspection. If such is the case, they are bound to become in time either useless or wasteful—that is to say, they will either not let anything through them or will go too much the other way and pass steam and water indiscriminately. Traps should be in sight, above the floor level, and under constant observation; if placed like this, leaking and waste or refusal to work are bound to be noticed at once.

Condensation losses through long runs of pipe can only be minimized by judicious manipulation of the section valves, allowing only just as much pipe to be alive as is commensurate with convenience and safety. This in some large stations has been reduced almost to a fine art, and there is no getting away from the fact that the amount of thought and organization necessary is amply repaid by the increase in efficiency. In a large station with a dozen or more boilers, and perhaps as many steam sets, the efficient working of the pipe range is by no means a simple matter, the economic possibilities, of course, depending greatly upon the style of arrangement. The only way to secure maximum economy is to work upon a system—that is to say, as far as practicable, certain engines should be run when certain boilers are in service, taking care that the steam way is the shortest possible between the two. In a small station, or with a simple straightforward arrangement of piping, there is not much in it, but with some of the old-fashioned elaborate ring or duplicate systems that are fortunately dying out, the possibilities are immense.

Much has been said about pipe and boiler coverings, particularly by manufacturers. It is therefore only necessary to reiterate that to allow even the smallest portion of steam piping to go inefficiently covered or entirely bare, is simply throwing money away. Condensation tests on covered and uncovered pipe are frequently quoted, and the writer would commend their perusal to engineers who do not appreciate the enormous losses entailed by bad lagging.

In all well managed stations the engines are indicated at frequent intervals—a very necessary precaution, from the neglect of inefficiency often arises. The comparative economy of engines, of course, depends chiefly upon their design and building, and cannot be improved unless drastic structural alterations are made, but it is necessary to guard against the minor losses that occur through wrongly set valves, leaky joints, glands, etc., and the frequent use of the indicator is the only way to check the first and most important of these. It is not sufficient to take cards and so get an indication of the general action of the steam in the cylinders—they should be worked out in order to ascertain whether the work is evenly distributed; if it is not, an uneven turning moment is the result, and unequal wearing of the brasses. This, when very bad, has often been the cause of persistent hot bearings on one side of the engine, and consequent expense and trouble in repairs, that by an intelligent use of the indicator might have been entirely obviated. The glands of inclosed engines when covered in naturally do not, as a rule, receive as much attention as those of the open type; they are, however, apt to be just as troublesome. The surest indication of their leaking is excess of water in the crank chamber, and if the amount of this is systematically observed, a certain check can be kept upon their condition.

In all stations during the heavy load it is necessary to keep a certain amount of plant in condition to be put to work at the shortest notice. From the point of view of economy this is a very important point, indeed, and a great deal of experience is necessary to say when the expense of keeping spare plant turning over or warmed up is exactly counterbalanced by the increased safety. The primary considerations are, of course, the condition of all or any one of the running sets or boilers, as regards freedom from breakdown, the amount and nature of the load, and whether rising or falling; upon these, again, is imposed what may be termed the component of local conditions, and the whole makes a very pretty problem for each individual station engineer.

To tackle the question from the commencement, boiler stand-bys, in anything but the very largest stations, are practically unnecessary—that is to say, if the boilers are well looked after. There may be a little risk in this, but the expense of getting up steam in a spare boiler every day, only to let it down again, is in most cases prohibitive. In a small station, therefore, there is but little choice in the matter—so many boilers will be required for the peak of the load, and so many must be steamed. Until the maximum is reached, and after it, there is plenty of stand-by; the only risk taken is at the peak, and as this is not as a rule on for long, it is worth running. In a large station, however, things may be rather different; the expense of steaming up a spare boiler or two is proportionately small, and the usual procedure, therefore, is to use more than enough boilers for the work, thus having something in hand in the event of breakdown. As it does not pay to force boilers, this method, besides being safe, is perhaps economical, and its use in small installations is only debarred by the proportionately large cost of raising steam and banking fires.

It is on a rising load that stand-by engines are chiefly required. When the load is falling this precaution is in most cases not so necessary. It all, however, depends upon conditions, such as the size of the sets, and whether they can be run up to speed quickly. If they are small and of the high speed inclosed type, warming up is generally sufficient to meet all the requirements of safety, as such engines can be got up to full speed from standing in a few seconds; but with heavy plant the case is different, and unless the spare set can be run up to speed and ready for taking load, say, in about 30 seconds, it is necessary to keep it turning over. This, of course, entails unprofitable use of steam—that is to say, unprofitable, inasmuch as it does not go towards the generation of current—but it is a highly necessary precaution, and on a rising load the loss is scarcely to be begrudged, seeing that the spare set will probably go into parallel very shortly. In the case of a fog load, questions of economy in this direction must, of course, be thrown to the winds; but in dealing with the ordinary evening load, with its predetermined value at certain times, a system based upon observations and energetically carried out, will do much to reduce what is sometimes the very considerable loss entailed by the keeping ready of stand-by plant.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

Mr. C. D. Shawl, formerly at Pendleton, Ind., has been appointed Manager of the gas division of the properties of the Cleburne (Tex.) Gas and Water Company.

Mr. Irvin Butterwotth, of the Detroit City (Mich.) Gas Company, has received orders to go to Denver, Col., there to assume the posts of President and General Manager of the Denver Gas and Elecric Company. His successor at Detroit will be Mr. A. P. Lathrop, who resigns the Presidency of the St. Paul (Minn.) Company, in order to take the Vice-Presidency and General Managership of the Detroit concern. Mr. Paul Doty, General Manager of the Denver Gas and Electric Company, goes to St. Paul, where he is to act as Second Vice-President and General Manager of the St. Paul Gas Light Company. Take up your beds and walk, gentlemen!

The Hon. D. N. Kennedy, Treasurer of the Clarksville (Tenn.) Gas Light Company, died at his home in that city, April 23d. He was born in Elkton, Ky., Feb. 28, 1820, was engaged in the drygoods business in

Nashville, Tenn., as his first commercial venture, from 1838 to 1842. In 1842 he removed to Clarksville where the rest of his life was spent. He was singularly fortunate in his trys with fortune, and particularly so in his relations to the banking and railroad interests of Tennessee. He was President of the Northern Bank of Tennessee for 45 years, an institution that he assisted in forming in 1854. His connection with the Clarksville Gas Company, to our knowledge, covered quite over a third of a century.

THE United Gas and Electric Company, which is now in complete control of the gas and electric lighting supply of Litchfield, Ills., proposes to make notable betterments on both divisions of its properties. The active man in the concern seems to be Captain David Davis.

REFERRING to a recent item in the JOURNAL that a Receiver had been applied for the Dover, Rockaway and Port Oram (N. J.) Gas Company, Addison Ely, Counselor at Law, Rutherford, N. J., has this to say: "A bill was filed in Chancery of New Jersey to compel an accounting as to the amount of the income of the Gas Company so that the Town of Dover might ascertain the amount of the 2 per cent. due under the franchise to it. The bill incidentally prayed for a specific performance of the contract between the Gas Company and the Town of Dover, and prayed that after an accounting, if the percentage was not paid, that the Court might appoint a Receiver to take the income of the Company and apply it to the paying of the percentage. There was no allegation of insolvency nor any attempt at such allegation. The obligations of the Company are very small indeed, except what it owes to me personally, and as I own all of the stock, except 22 shares, and all the issue of bonds, and am investing my money to make stocks and bonds good, my debt against the Company can hardly be considered."

MR. J. B. COOKE has been appointed Superintendent of the gas department of the Birmingham (Ala.) Railway, Light and Power Company, vice T. Byron, resigned.

MR. THEODORE K. JACKSON. Manager of the Enid (Okla.) Electric and Gas Company, was elected First Vice-President of the Southwestern Electric and Gas Association, at the meeting of that reorganized body in Dallas, Tex., last month.

MR. J. A. MAYERS informs us that the Gas Machinery Company, of Cleveland, O., has been awarded a contract for the placing in the works of the Bronx Gas and Electric Company, Westchester, N. Y., of a set of duplex purifier boxes, rated to a capacity of 1,000,000 cubic feet per day. The Bronx Company will provide new buildings for the housing of the boxes.

A CORRESPONDENT in St. Louis, writing under date of the 9th inst., says: "Section 15A, Palace of Manufactures, World's Fair, St. Louis, will prove an interesting one to the gas fraternity. This section was finally awarded, the middle of January, to the Western Gas Construction Company, of Fort Wayne, Ind., for the purpose of making an exhibit on gas lines, which exhibitions have heretofore been so meager in World's Fairs. On the named space, about 61 feet long with extreme width of about 58 feet, the Western Gas Construction Company has erected, in systematic order, a complete line of apparatus for the manufacture of both coal and water gas, and an example of the Company's duplex purifying system. The coal gas apparatus embraces bench mountings, P. & A. apparatus, tar extractors, condensing system, ammonia washer and rotary scrubbers, with a number of detail apparatus in conjunction with the fixing part of the industry. The water gas apparatus includes a complete platform design of machine, including tar extractors and washers. In addition thereto the Company has on display a full-sized sectional apparatus of extended carburetter design, 8 feet 6 inches, showing the arrangement of hydraulic-operated valves. Purification is represented by a quarter section of 16 by 20 full size duplex purifiers with valves, elevated on full height columns with stairways and upper platforms, from which a magnificent view can be obtained of the entire building. A full size ammonia concentrator has also been placed, with all the necessary detailed equipment. Fronting the main aisle are 3 columns, built up to a height of about 36 feet, from valves and fittings, commencing with 4-inch valves. The columns are connected with a 20-inch wrought iron pipe, about 16 feet above the floor, which, with other connecting pipes, carry two large 'W.'s,' handsomely and effectively illuminated by gas. The center column is fitted with a platform about 6 feet in height, from which the valves are operated from the different styles of valve stands manufactured by the Company. The auxiliary apparatus arran ged between the main exhibit as above, embraces retort house tools, a 3-million capacity P. & A., many different sizes of angle, gate and governor valves, etc., permitting detailed explanation; also, mu ltiple pressure boards, hydraulic coke or coal hoist for water gas generators, analytical apparatus, thermometers, etc., and a complete set of general and detailed drawings, which will be exhibited to inquiring visitors by the Company's representative. To complete the exhibit systematically, 2 Roots' exhausters have been properly placed, accompanying which, or nearby, the regular standard outfit of engine and Sturtevant blower will be found; also, an example of direct-connected De Laval turbine and Sturtevant blower. In the center of the space is a neatly finished office, about 12 feet square, which is furnished with a view of taking care of the comfort of visitors. The Western Gas Construction Company will also be represented in the exhibit of the Western Gas Association by a display of sample apparatus, such as special designs of ammonia washers, P. & A. apparatus, gate valves, multiple pressure boards and a model of the Holmes rotary scrubber.

"In order to carry the scheme through to completion it was deemed advisable to exclude electric light as not in harmony with the broad idea that prompted this special exhibit. Arrangements were therefore made for illuminating the entire space with incandescent gas lighting. The matter was placed in the hands of the General Gas Light Company, of Kalamazoo, Mich., which concern took the plan up in good earnest. The two corner columns will be surmounted by large incandescent gas lights. The top of the large 'W' will carry 2 special cluster burners, each of about 1,200-candle power, and throughout the exhibit will be distributed totally about 10,000-candle power to be maintained during the time of the Fair. A further interesting feature of the Western's main exhibit is in the fact that adjoining its display is that of the Laclede Firebrick Company. This exhibit shows a complete installation of 9's on the inclined plan, settings of half-depth 6's and many examples of firebrick products used in and about gas works. The Western Gas Construction Company invites every gas man who visits the World's Fair to examine its display and partake of its hospitality."

WE regret to report the death, at his home in Denver, Col., the morning of the 5th inst., of Mr. Horace Munson, a prominent member of the office staff of the Denver Gas and Electric Company. He was 26 years of age, having been born in Lincoln, Neb., May 5th, 1878.

THE Nyack (N. Y.) Gas Light and Fuel Company has acquired control of the properties of the Rockland Light and Power Company, of Nyack. The concerns will be operated on a nominally independent basis, but Mr. A. W. Voorhis and his associates of the gas division of the enterprise will more or less direct the operations of existing interests.

THE Otto Gas Engine Works Company, of Philadelphia, has deecided to remove its factories to Wilmington, Del.

THE Detroit Gas Arc Lamp Company has filed notice of dissolution. The record was made in Detroit, April 28th.

MR. HENRY ROCHAT, formerly of New Orleans, La., has been appointed Assistant Superintendent of Distribution to the Cincinnati Gas and Electric Company.

THE proprietors of the Westerly (R. I.) Gas and Electric Company have announced a rate of $1.25 per 1,000 cubic feet for gas sold for cooking, heating and power purposes.

AT the annual meeting of the Erie (Pa.) Gas Company, the Directors elected were: E. D. Carter, Paul Mueller, H. E. Fish, J. S. Rilling, H. F. Wilbur, Louis Strueber and H. L. Moore.

THE Kerr Murray Mfg. Co., of Fort Wayne, Ind., has been awarded the contract for the improvements to be made this season on the gas division of the plants of the Muskegon (Mich.) Lighting and Traction Company.

AT the "last" meeting of the proprietors of the Mauch Chunk (Pa.) Gas Company, the officers chosen were: Directors, A. E. Forstall, A. H. Strecker, H. A. Rutter, E. H. Blakslee, S. P. Curtis, L. H. Barber and A. P. Blakslee; President, H. A. Rutter; Vice-President, A. E. Forstall; Secy. and Treas., L. N. Lincoln.

The Market for Gas Securities.

The oddity that occupies the position of Governor of New York has vetoed the measure known as the Remsen gas bill. The Consolidated Gas Company will now go about its business in a commonsense way. The stock broke to 203, but subsequently rallied to 210½, closing to-day (Friday) at 207½ to 207¾. It is about determined that the Company will issue $20,000,000 four per cent. bonds, convertible into stock after 2 years.

Brooklyn Union has increased its dividend rate to 2½ per cent. quarterly, and is expending well on to $500,000 in main replacing and extending. Consolidated, of Baltimore, 67½ bid, ex-div., and Peoples, of Chicago, is 94½ to 95, ex. Hudson County (N. J.) gas is 67 bid, and there was fair inquiry for its bonds at 103½. Indianapolis, Ind., is strong, and one clever investor informed us recently that it should be good for 90 by September next.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

MAY 16.

☞All communications will receive particular attention.

☞The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$73,177,000	100	207¼	207⅛
Central Union, Bonds, 5's	3,000,000	1,000	106⅛	108⅛
Equitable Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	118	120
Metropolitan	658,000	..	108	112
Mutual	3,500,000	100	270	300
Municipal Bonds	750,000	..	..	..
New Amsterdam Gas Co. .. Bonds, 5's	11,000,000	1,000	105½	106
New York & Richmond Gas Co. (Staten Island)	1,500,000	100	34	..
1st Mtg. Gold Bds. 5 p. ct.	1,000,000	..	..	..
Northern Union, Bonds, 5's.	1,250,000	1,000	102⅛	105⅛
New York and East River.. Bonds 1st 5's	3,500,000	1,000	109⅛	111
" 1st Con. 5's	1,500,000	..	106	108
Standard	5,000,000	100	125	13
Preferred	5,000,000	100	145	155
Bonds, 1st Mortgage, 5's	1,500,000	1,000	116	117
Yonkers	299,650	500	130	..
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	216	227
" " Bonds (5's)	15 000,000	1,000	113	115
Bay State	50,000,000	50	¼	⅝
" Income Bonds	2,000,000	1,000	..	75
Binghamton Gas Works..	450,000	100	28	30
" 1st Mtg. 5's	509,000	1,000	93	96
Boston United Gas Co.— 1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	3¾	4
" " Bonds, 5's	5,250,000	1,000	12¾	..
Capital, Sacramento..	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Cincinnati Gas and Electric Co	29,500,000	100	100⅛	101
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	101	101⅛
Columbus (O.) Gas Lt. & Heating Co	1,682,750	100	88¼	89¼
Preferred	3,026,500	100	107⅛	109
Consumers, Toronto	1,700,000	50	218	225
Consolidated, Baltimore..	11,000,000	100	67⅜	68x
Mortgage, 6's	3,600,000	..	..	118
Chesapeake, 1st 6's.	1,000,000	..	..	..
Equitable, 1st 6's.	910,000	..	..	..
Consolidated, 1st 5's..	1,490 000	..	..	119
Consolidated Gas Co. of N.J.	1,000,000	100	15	17
" Con. Mtg. 5's	880,000	1,000	86	90
Consolidated G. & E. Co.'s. Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co.	4,825,500	50	..	50
" Prior Lien 5's	5,603,000	1,000	99⅛	100
Detroit Gas Co., 5's	381,000	1,000	75	75¼
" Inc. 5's	16,000	100	98⅛	100
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Essex and Hudson Gas Co.	6,500,000	..	39	40
Fort Wayne	2,000,000	..	..	..
" Bonds	2,000,000	..	55	..
Grand Rapids Gas Lt. Co. 1st Mtg. 5's	1,225,000	1,000	104⅛	105
Hartford	750,000	25	245	265
Hudson County Gas Co., of New Jersey	10,500,000	..	67	68
" Bonds, 5's	10,500,000	..	103½	104⅛
Indianapolis	2,000,000	..	60	70
" Bonds, 6's	2,650,000	..	103½	106½
Jackson Gas Co	250,000	50	73	75
" 1st Mtg. 5's	290,000	1,000	101	102½
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	36
Bonds, 1st 5's	3,822,000	1,000	102	104
Laclede, St. Louis	10,000,000	100	90	100
Preferred	2,500,000	100	80	100
Bonds	10,000,000	1,000	109⅛	110
Lafayette Gas Co., Ind	1,000,000	100	..	60
Bonds	1,000,000	1,000	60	65
Louisville	2,570,000	50	136	140
Madison Gas & Elec. Co. " 1st Mtg. 6's	350,000	1,000	107½	108¼
" 6 per cent. scrip, due 1910	100,000	25	85	87
Montreal, Canada	2,000,000	100	218	184¾
Nashville Gas Lt. Co.	1,000,000	100	110	..
Newark, N. J., Con. Gas Co.	6,000,000	..	56	58
Bonds, 6's	4,600,000	..	105	105¾
New Haven	1,000,000	25	64	70
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	94½	95x
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	30,100,000	1,000	..	..
2d "	2,500,000	1,000	104	.
Rochester Gas & Elec. Co..	2,150,000	50	88	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	15,800,000	100	58½	58¾
St. Joseph Gas Co. " 1st Mtg. 5's	751,000	1,000	92	96⅛

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Position Wanted

By a man having 15 years' experience in the repairing and proving of gas meters.

Address, "G. L.,"

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Position Wanted

By a young man with 7 years' experience in the gas and electric business as bookkeeper, solicitor and general business man, with a knowledge of the manufacture of coal and water gas. Good references.

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Wanted, Position

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Of gas, or gas and electric light plant, by a man who can show first-class results in former positions. South or Southwest preferred.

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HARD PROPOSITION WANTED.

The Management of a Gas Plant,

In a city of 12,000 inhabitants or more, in need of a business getter, wanted by a competent gas man. Compensation, in the form of interest in the business based on results obtained, preferred. Address, "MANAGER."

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With a Gas Company Desiring a Competent Engineer

Having civil engineering qualifications and good references. Address, "B.,"

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Young man, 8 years' experience on gas works construction and structural ironwork, wants position. Address, "BOX 7,"

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Reliable, Experienced Man as Foreman

In charge of men and operation of Pintsch gas plant located in Middle West. Must also understand reports and simple accounts. Accompany application with references, full particulars and salary expected.

Address, J. A. DIXON, 160 Broadway,

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WANTED TO PURCHASE

A SECOND-HAND EXHAUSTER,

In first-class condition, with 6-inch or 8-inch connections. Address, "W. C. M.,"

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WANTED,

Second-hand, U. G. I. Double Superheater, 4-foot Shell.

Capacity, 125,000 cubic feet; with scrubber and condenser. Address, "O. P.,"

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A SECOND-HAND LOWE WATER GAS SET

Capable of producing 400,000 to 500,000 cubic feet of gas per day. Please give full particulars as to price, length of time set has been used, general condition, and maker's name.

Address, "LOWE,"

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Three Davis & Farnum Purifiers,

Twelve feet by 24 feet by 4 feet. Also,

One 50-Horse Power Bigelow Boiler.

All in good condition. Address,

PAWTUCKET GAS COMPANY,

1506-tf PAWTUCKET, R. I.

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500 THREE-LIGHT METERS,

Guaranteed in perfect condition, having been thoroughly overhauled, are offered for sale at bargain prices. Write for particulars.

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FOR SALE,

FOUR CAST IRON PURIFIERS,

8 feet by 10 feet by 4 feet deep, with 30-inch seal. Complete, with centerseal and connections. Boxes in fine condition and will not need repairs of any kind. Are now in use, but will be loaded immediately on sale. Address,

CLINTON GAS LIGHT & COKE CO.,

1508-3 CLINTON, IOWA.

FOR SALE,

Ironwork for stack of 6 benches of 6 retorts each; modern apparatus. Two wrought iron hydraulic mains, with pockets in back. Mouthpieces; standpipes; dip-pipes with valves; buckstays; furnace doors, etc. Prices reasonable. A good chance to get a good outfit cheap. Address,

WORCESTER GAS LIGHT COMPANY,

1508-5 WORCESTER, MASS.

FOR SALE.

One Section Wrought Iron Hydraulic Main, with Stiness tar take-off, for 3 benches of 6's.

One Section Main, for 4 benches of 6's.

Standpipes, Bridgepipes, Mouthpieces with Self-sealing Lids, for 7 benches of 6's.

One Sinuous Friction Condenser.

One Walker Tar Extractor.

One Standard Scrubber.

Four Purifiers, 10 by 16 by 3; complete. Connections above apparatus, 10-inch.

One 50 Horizontal Return Tubular Boiler.

All of the above apparatus is in good condition, and to be sold, as the company has been obliged to purchase larger for its new works. Address, TAUNTON GAS LIGHT CO.,

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Lot of second-hand

THREE-LIGHT METERS,

in splendid condition; as good as new. Also one

NINE-FOOT STATION METER,

with a capacity of 1,000,000 cubic feet per 24 hours. Address, "VINDEX,"

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GAS, ELECTRIC LIGHT AND HOT WATER HEATING PLANT.

Town, 8,000; near coal fields; $10,000 cash, balance when Court confirms sale.

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Ironwork for 9 benches of 6's; hydraulic mains, 24 inches by 24 inches, with diaphragm and cleaning pockets; plain mouthpiece, 14 inches by 24 inches; 6-inch stand, straddle and dip pipes. Address,

BIRMINGHAM RAILWAY, LIGHT AND POWER CO.,

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Utilize Your Gas Liquor.

NO EXTRA LABOR OR OPERATING EXPENSES.

IMPROVED AMMONIA CONCENTRATOR.

About 100 in use. Write to

STROH & OSIUS, Patentees, or

MICHIGAN AMMONIA WORKS, - Detroit, Mich.

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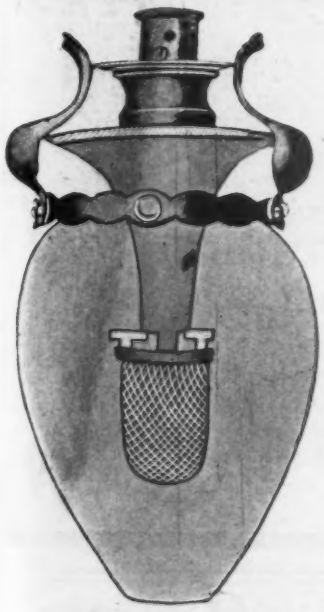
J. F. W. JOST,
CHEMICAL ENGINEER
—IN—
GAS MANUFACTURE,
P. O. BOX 2043, PHILADELPHIA, PA.

FOX HILL FOUNDRY,
F. FERGUSON & SON,
HOBOKEN, N. J.
FINE OPENING
GRATE BARS
FOR GAS WORKS.
STATIONARY, SHAKING, DUMPING.
BARS FOR HAZELTON BOILERS.

The Latest Novelty in Gas Lighting is the
PATENT INVERTED INCANDESCENT GAS BURNER.



One third full size.
Price: Burner with Mantle and Globe, $2.50.

No. 1 BURNER.

The most up-to-date and economical system of gas lighting, artistic in appearance, absolutely shadowless, and readily attached to existing fittings.

A BRILLIANT WHITE LIGHT OF 65 STANDARD CANDLE POWER.

Gas Consumption only 3 Cubic Feet per Hour.

The decorative appearance of Electric Light at one-eighth the cost.

THE "BIJOU" BURNER

Is the nearest approach to Electric Light, and lends itself more than any other gas burner to private house lighting, having an exceedingly pretty effect, especially when fixed in clusters of two, three or five lights.

20 standard candle power.

Consumption of Gas, 1 foot per hour.

One-third full size.
Price: Burner with Mantle and Globe, $2.

The New Inverted Incandescent Gas Lamp Co., Ltd.,
GEO. G. RAMSDELL, Agent,
530 BROADWAY, • • NEW YORK.

PARKER-RUSSELL MINING AND MFG. CO.,

OF ST. LOUIS, MO.,

PROPRIETORS OF THE

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WE MAKE A SPECIALTY OF WATER GAS LININGS AND CHECKER BRICK.

Half and Full Depth Benches of Our Own Design, Containing 6, 8 or 9 Retorts.

SLOPERS.--We have perfected plans of INCLINED RETORT BENCHES, designed to meet conditions prevailing in America, and constructed entirely of American materials.

We Build Benches Complete. Ready for Gas Making. Also,

RETORT HOUSES,

COAL and COKE CONVEYING MACHINERY.

Plans, Specifications and Estimates Cheerfully Furnished.

CORRESPONDENCE SOLICITED.

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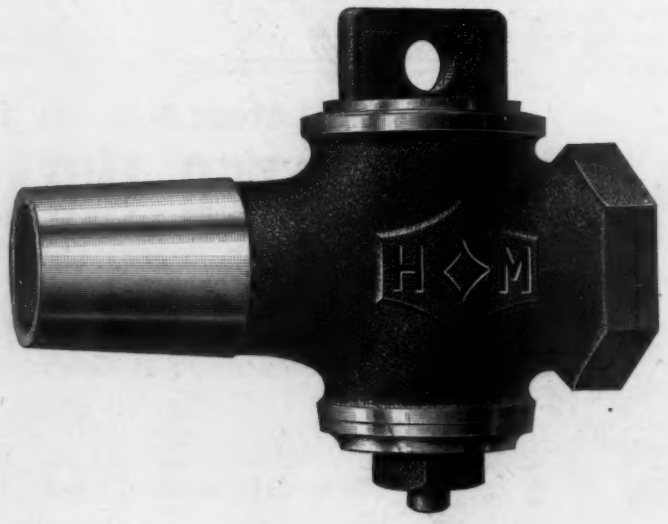
Mueller Gas Cocks are made in a large variety of styles so as to avoid this inconvenience and expense on the part of the buyer. They are made in 48 styles each, of straight, round and oval way patterns, the round way being produced in two grades, the oval in one grade, and the straight in three grades.

FLAT HEAD METER COCK.



Mueller Gas Cocks have the metal well balanced for strength of parts, and the cores are set to produce a smooth inner surface and evenly balanced walls. The cock illustrated herewith is a special grade, straight way pattern, meter cock.

Each Mueller Gas Cock is given an actual working test with hydraulic pressure, bears the Mueller trade-mark, and is *unconditionally guaranteed.*

Mueller Gas Cocks are on exhibit in the Palace of Manufactures, World's Fair.

H. MUELLER MFG. CO., DECATUR, ILL., U. S. A.

FREDERIC EGNER,

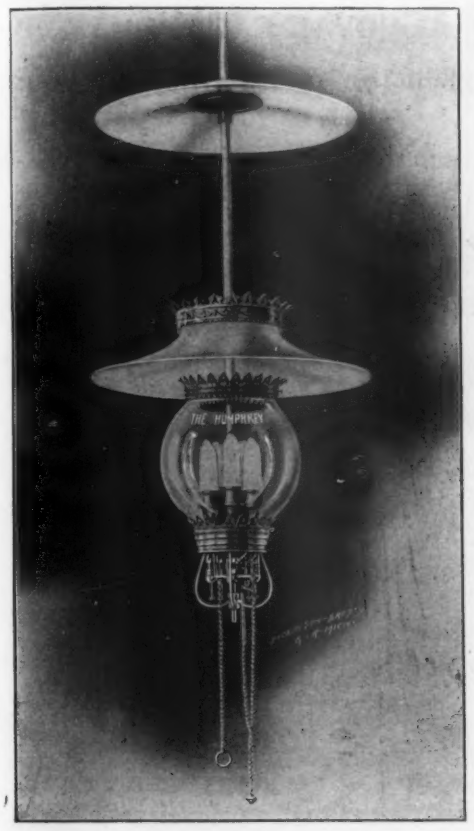
Gas Engineer,

WASHINGTON BANK BUILDING, 12TH & G STS., N. W., WASHINGTON, D. C.,

May be consulted with reference to estimates of cost for new, or appraising actual value of existing works; utility of proposed or patented processes; relative earning power to capitalization, and management. Will NOT undertake to furnish apparatus or material, or to contract for the erection of works.

Chollar's System of Gas Purification.

THE PURIFIED GAS REVIVES THE FOULED OXIDE.



THE HUMPHREY LIGHT is made in its entirety in our own shops. Our lamp business is not a side issue jobbed out among various brass workers. We are the designers and makers of the original gas arc light.

GENERAL GAS LIGHT CO.,
KALAMAZOO, MICH.

54 Warren Street, New York.
530 Market Street, San Francisco.

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TRENTON, N. J.,
Long Distance Telephone, 1922 Trenton, N. J.

Constructing Engineer and Contractor.

Estimates Furnished on any kind of Work in Connection with Gas or Water Plants.

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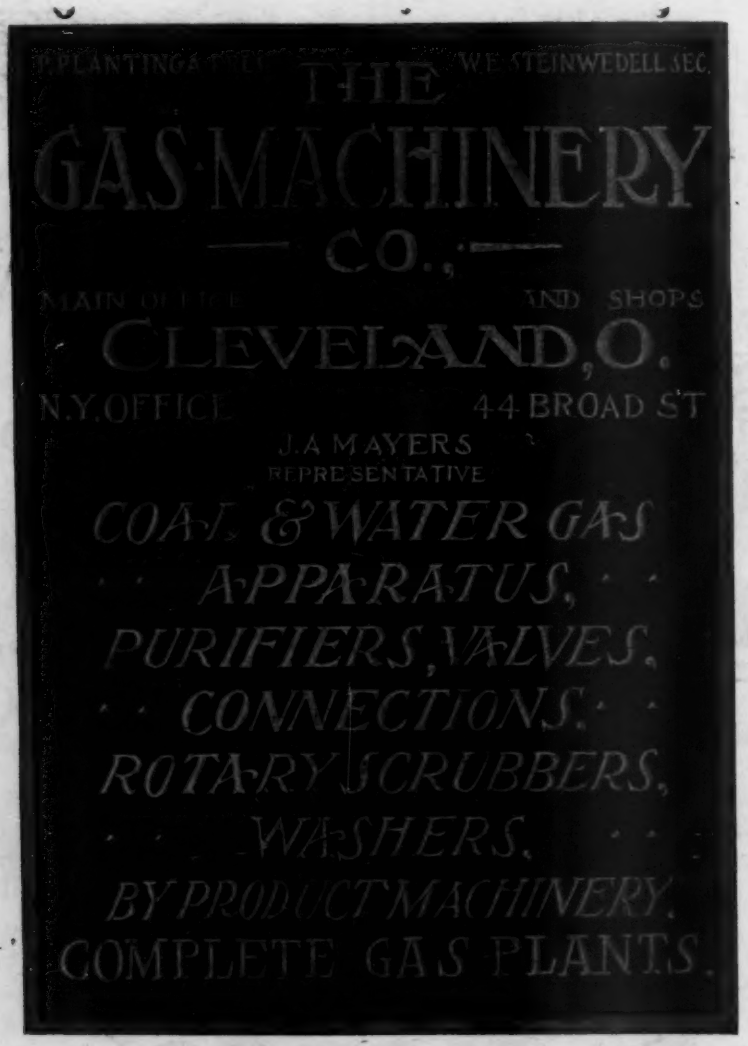

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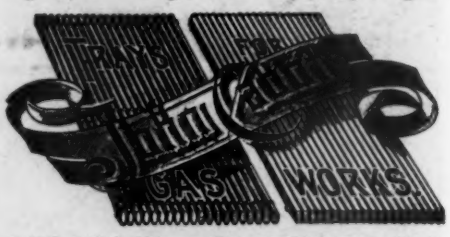

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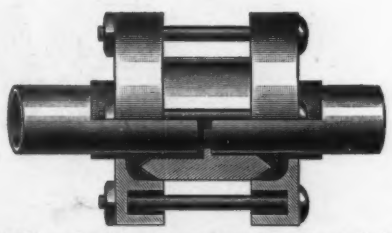
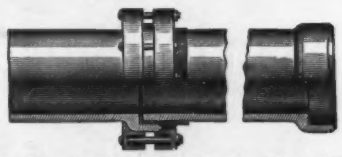
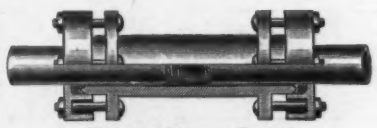


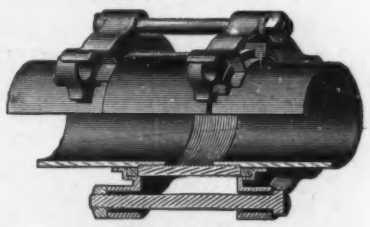
Insulating Coupling for Wrought Iron Pipe. Style 5.



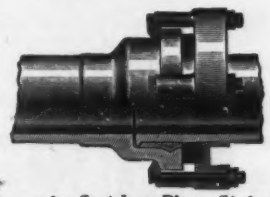
Insulating Coupling for Dresser Bell and Spigot Cast Iron Pipe. Style 6.



Regular Sleeve. Style 2.



Clamp. Style 4.



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Pipe Couplings, Sleeves, Clamps, Crosses, Tees and Ells.

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Economize Heat in Water Gas Plants,

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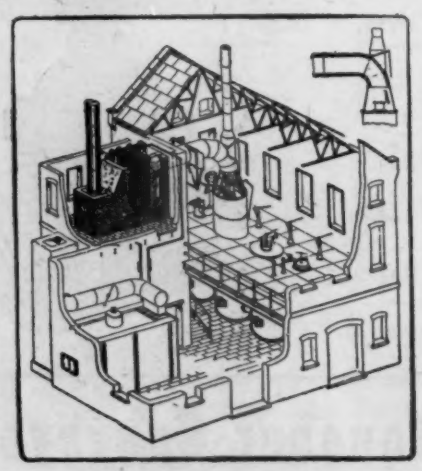

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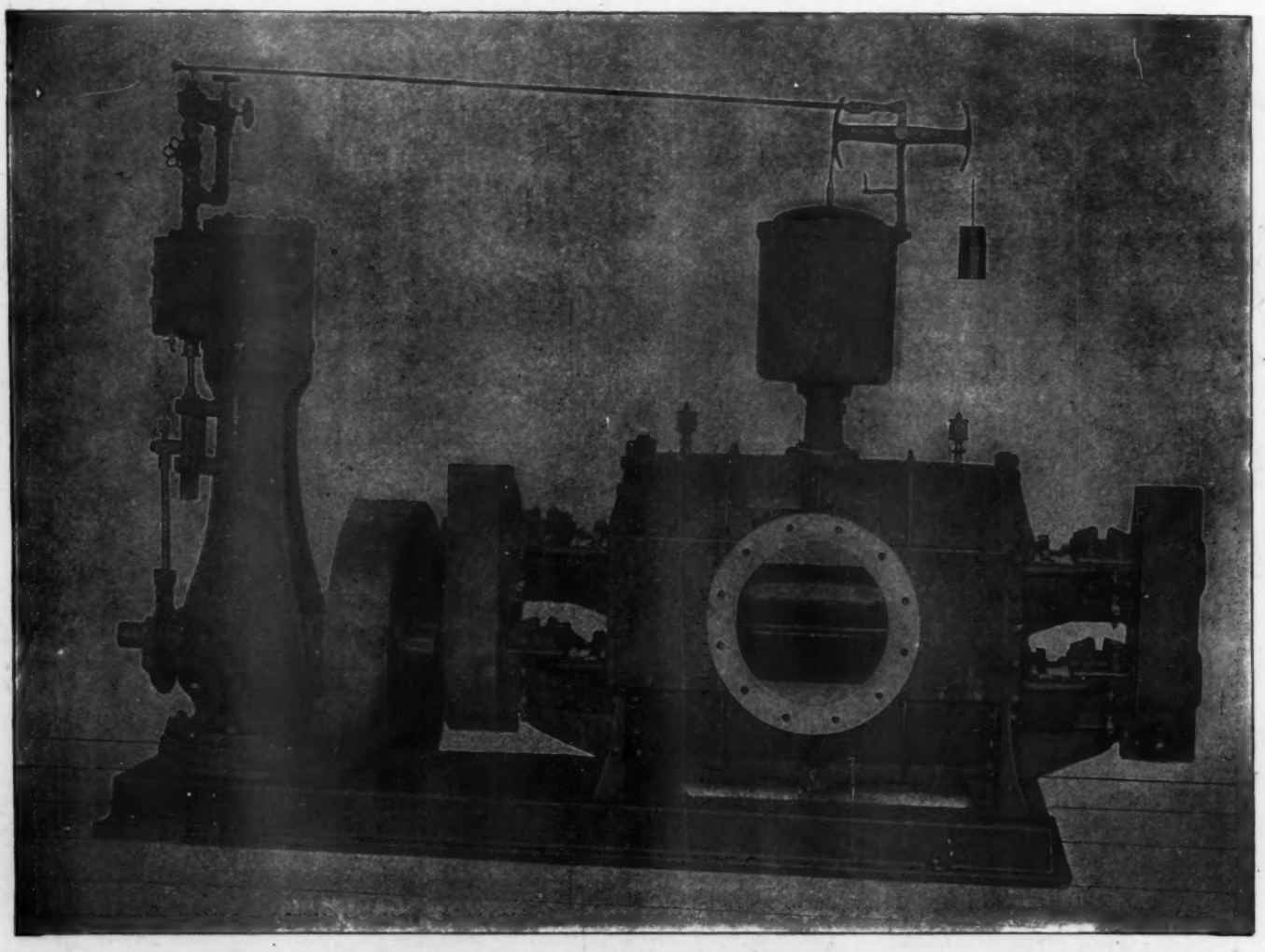

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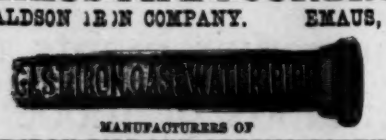

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Drilling and Tapping Pipe under Pressure
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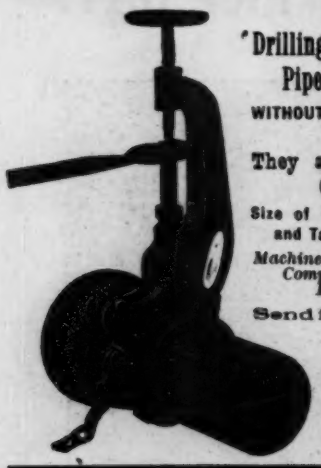

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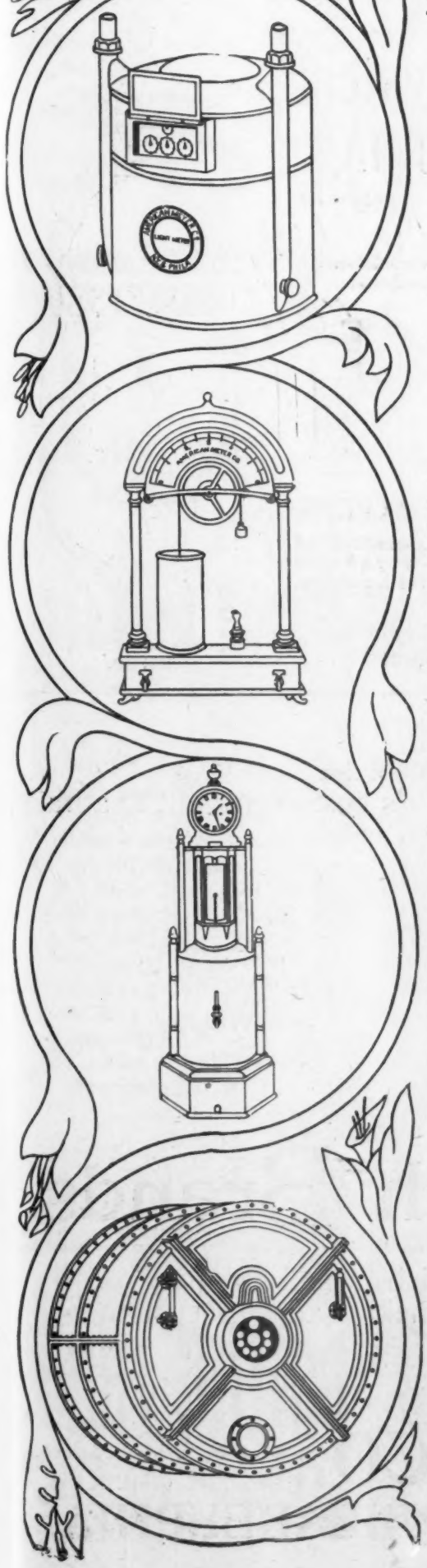
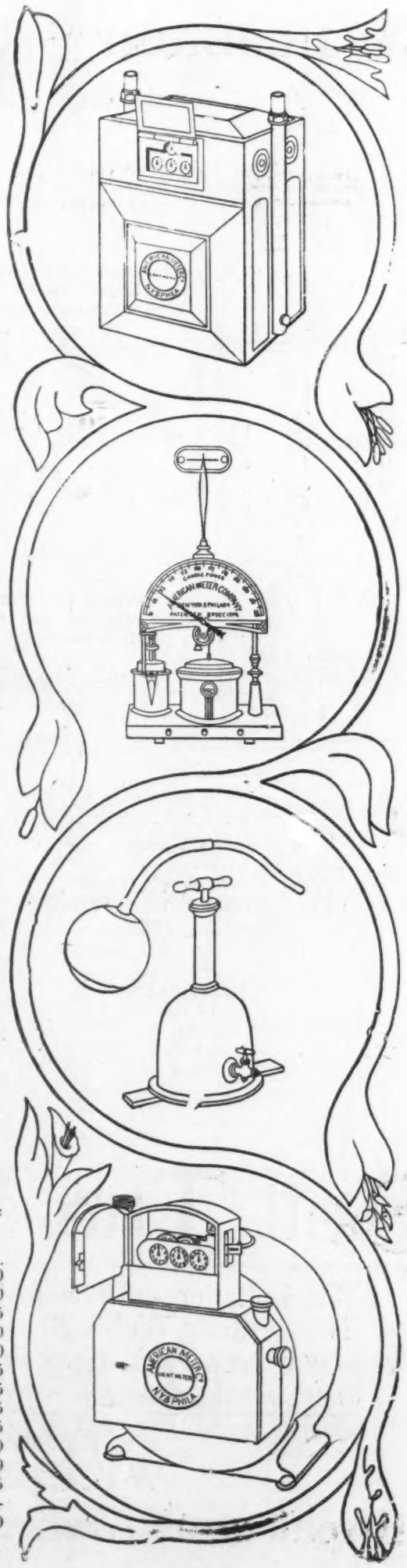




PUBLIC LIGHTING TABLE.

JUNE, 1904.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Table No. 1. Following the Moon. Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Table No. 2. New York City. All Night Lighting. Extinguish.
				P.M.	A.M.
Wed.	1	7.50 PM	11.10 PM	7.15	3.15
Thu.	2	7.50	11.40	7.15	3.15
Fri.	3	7.50	12.20 AM	7.15	3.15
Sat.	4	7.50	12.50	7.25	3.15
Sun.	5	8.00 LQ	1.20	7.25	3.15
Mon.	6	8.00	1.50	7.25	3.15
Tue.	7	8.00	2.20	7.25	3.15
Wed.	8	8.00	2.50	7.25	3.15
Thu.	9	8.00	3.30	7.25	3.15
Fri.	10	8.00	3.30	7.25	3.15
Sat.	11	8.00	3.30	7.25	3.15
Sun.	12	8.00	3.30	7.25	3.15
Mon.	13	8.00 NM	3.30	7.25	3.15
Tue.	14	8.00	3.30	7.25	3.15
Wed.	15	8.00	3.30	7.25	3.15
Thu.	16	8.00	3.30	7.25	3.15
Fri.	17	8.00	3.30	7.25	3.15
Sat.	18	10.10	3.30	7.30	3.15
Sun.	19	10.50	3.30	7.30	3.15
Mon.	20	11.30 FQ	3.30	7.30	3.15
Tue.	21	12.00	3.30	7.30	3.15
Wed.	22	12.40 AM	3.30	7.30	3.15
Thu.	23	1.20	3.30	7.30	3.15
Fri.	24	2.00	3.30	7.30	3.15
Sat.	25	2.40	3.30	7.30	3.15
Sun.	26	No L.	No L.	7.30	3.15
Mon.	27	No L. FM	No L.	7.30	3.15
Tue.	28	No L.	No L.	7.30	3.15
Wed.	29	8.00 PM	9.40 PM	7.30	3.15
Thu.	30	8.00	10.20	7.30	3.15

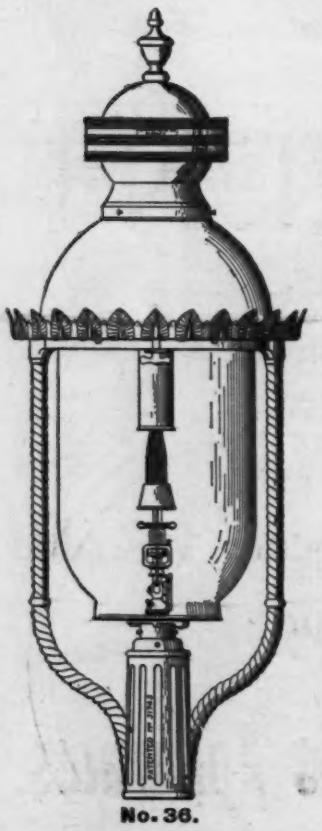
TOTAL HOURS LIGHTING DURING 1904.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	225.00	January	423.20
February	205.40	February	367.40
March	187.40	March	355.35
April	169.50	April	298.50
May	152.30	May	264.50
June	137.20	June	234.25
July	138.50	July	243.45
August	151.00	August	280 25
September	164.40	September	321.15
October	191.30	October	374.30
November	210.30	November	401.40
December	237.10	December	433.45
Total, yr.	2171.40	Total, yr.	4000.00

NEW YORK, 97 Liberty Street. BOSTON, 814 Beacon Building. PHILADELPHIA, Broad and Arch Streets. ST. LOUIS, 712 Roe Building. CHICAGO, Foot of Orleans Street. SAN FRANCISCO, 712 Polk Street.

WELSBACH STREET LIGHTING COMPANY

.... OF AMERICA ....



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POINTS OF MERIT:

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IT LIGHTS THE STREET.

Where there are no gas mains we can furnish an equally good light by our SELF-GENERATING NAPHTHA WELSBACH BURNER, and thereby supply a uniform light in all localities.

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The formula is simple-

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Sell The Welsbach Brands.

The imitation stuff is bad for the customer---which is bad for you.

The genuine Welsbachs---Burners or Mantles---make satisfied customers---keep customers---MAKE NEW ONES.

And your profit isn't merely dollars and cents.

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For the Year Ending December 31, 1903. has been Awarded Contracts in the Following Places for

Standard Double-Superheater Lowe Water Gas Apparatus.

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Baltimore, Md.	Lynn, Mass.	New York (Central Union Co.)
Chicago, Ills.	Newark, N. J.	Cicero, Ills.
Amesbury, Mass.	Washington, D. C.	Chicago (Ogden Co.)
Aberdeen, S. D.	Boone, Ia.	Easton, Pa.
Winsted, Conn.	Pueblo, Col.	Lawrence, Mass.
Canon City, Col.	Charlotte, N. C.	Council Bluffs, Ia.
Schenectady, N. Y.	Fall River, Mass.	Chattanooga, Tenn.
Hagerstown, Md.	Duluth, Minn.	Tuckerton, N. J.
Malden, Mass.	New York (Mutual Co.)	Springfield, O.
Bridgeport, Conn.	Waltham, Mass.	Easton, Pa. (2d contract).
Albert Lea, Minn.	Dover, Del.	Mobile, Ala.
Brooklyn, N. Y.	York, Pa.	Conshohocken, Pa.
Kansas City, Kas.	Minneapolis, Minn.	Mason City, Ia.
Hempstead, N. Y.	Allentown, Pa.	

TOTAL SETS FOR 1903, ... 62
TOTAL DAILY CAPACITY, ... 62,950,000 cubic feet.
TOTAL SETS TO DATE, ... 508
TOTAL DAILY CAPACITY, ... 362,780,000 cubic feet.

The United Gas Improvement Company,

Broad and Arch Streets, Philadelphia.

Established 1858. Incorporated 1890.
CHAS. E. GREGORY, Prest. DAVID R. DALY, V.-Prest. & Treas.
H. D. ABERNETHY, Sec.

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Also for Free-Firing and Full and Half-Depth Regenerative Benches, for Burning either Coal or Coke in the Furnaces.

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No. 3. Vertical retorts with vertical charge and discharge. Sixteen retorts in 1 bench.

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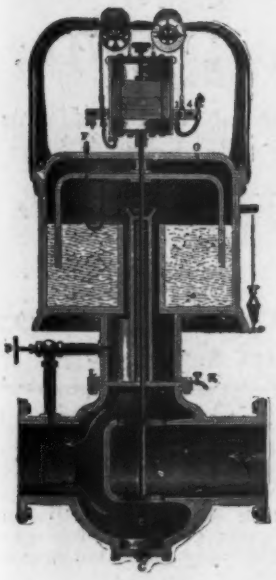

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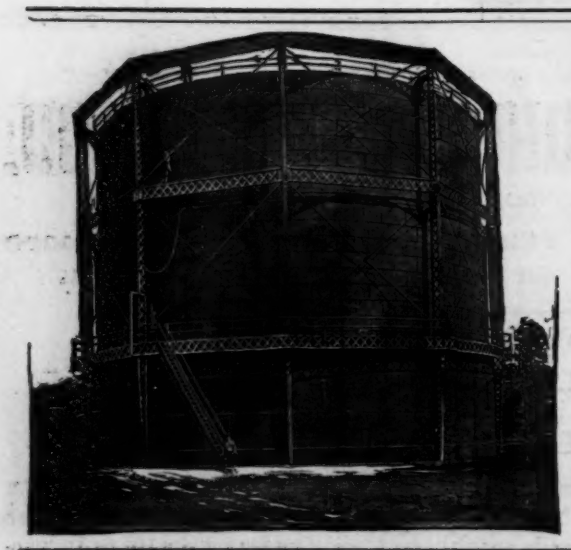

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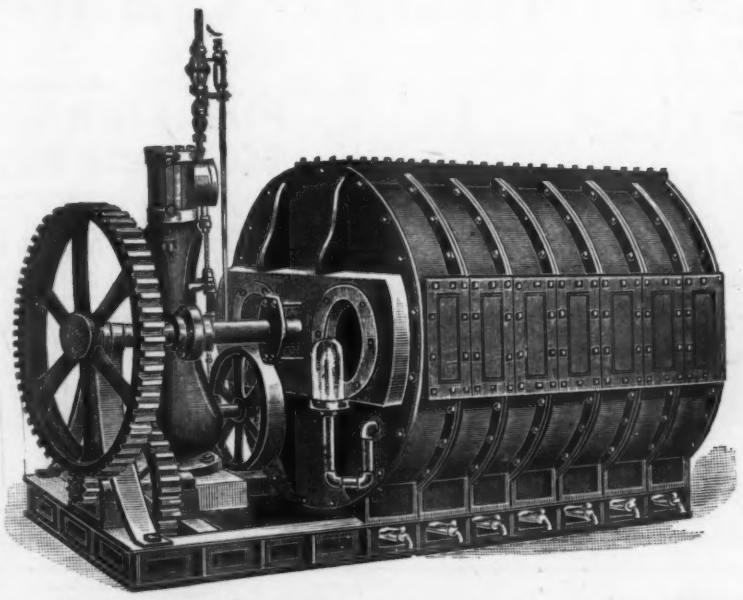

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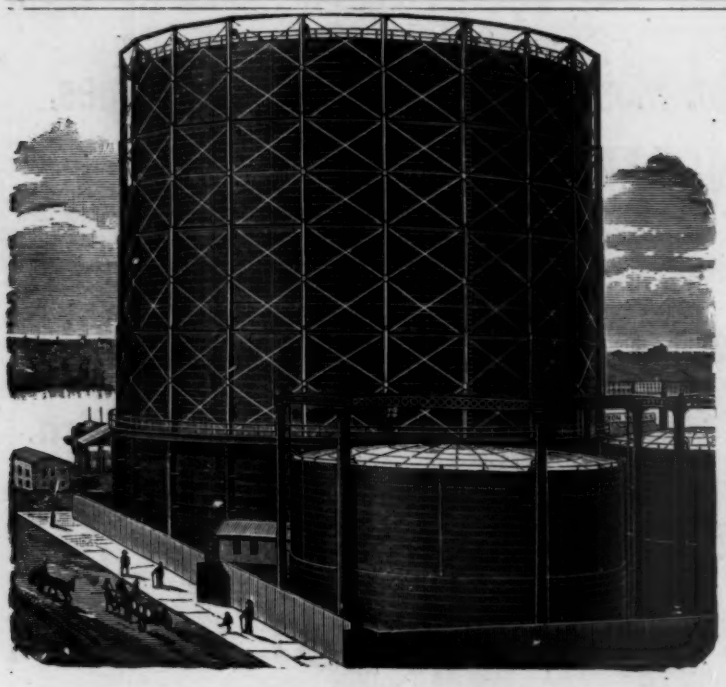

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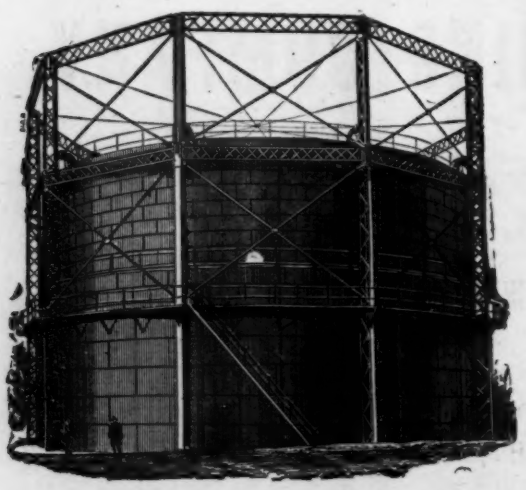

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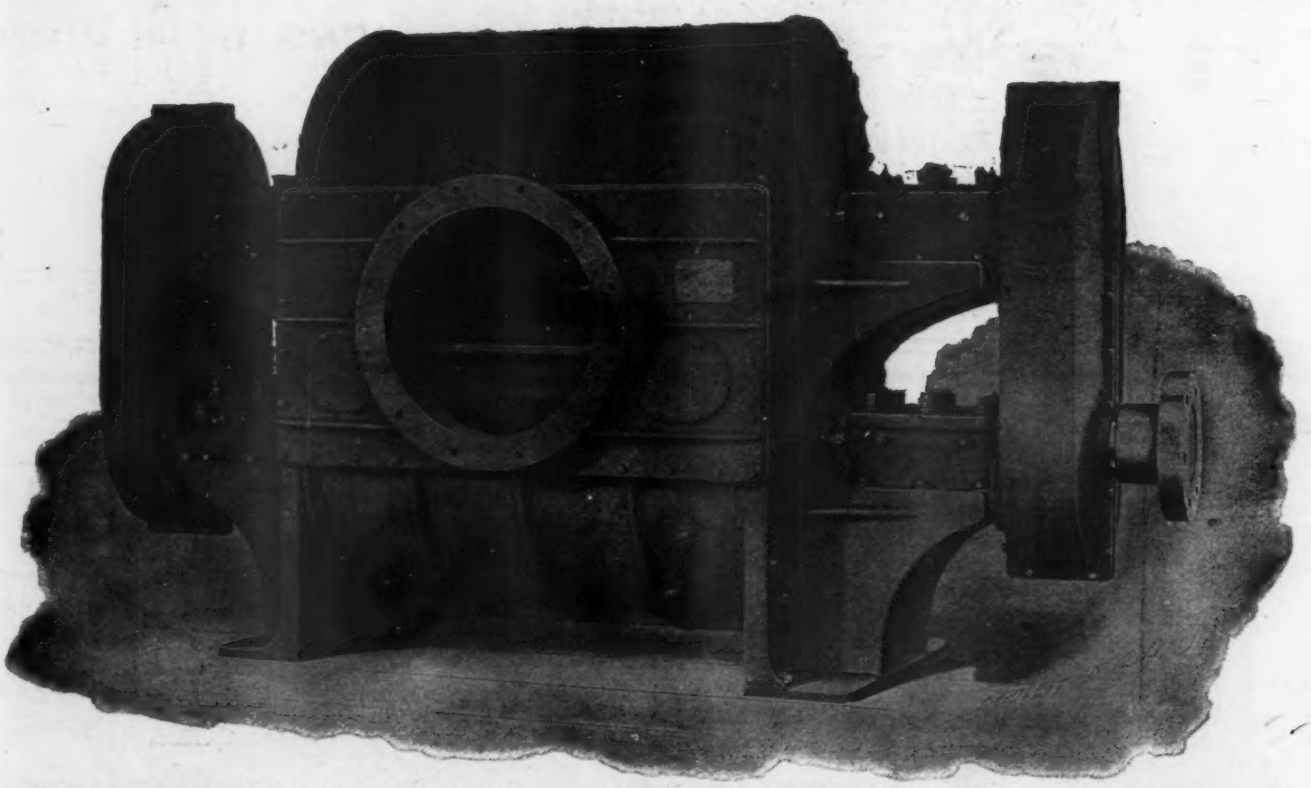

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